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THE BEACHY HEAD LIGHTHOUSE, RECENTLY COMPLETED.—[See page 358.]

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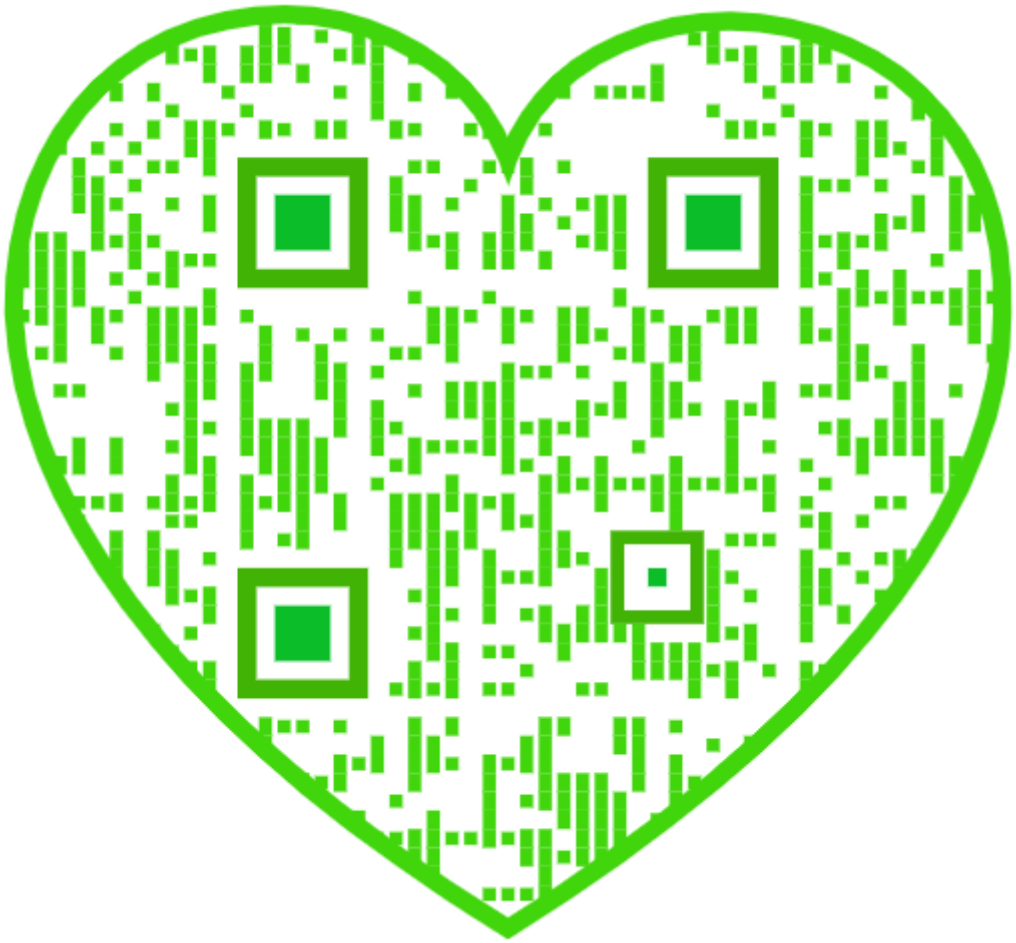

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NEW YORK, SATURDAY, NOVEMBER 29, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

REPORT OF THE CHIEF OF THE BUREAU OF ORDNANCE.

It is always with pleasure that we take up the Annual Report of the Chief of the Bureau of Ordnance, for there is no branch of the navy that is able to show at the end of each twelvemonth more uniformly satisfactory results. From the very inception of our new navy, the work of this Bureau has been marked by almost uniform success. Although at the time of the Spanish war we had dropped considerably behind the rest of the world in the matter of smokeless powder and high-velocity guns, the lost ground has been more than made up, and to-day our guns, gun mounts, powder and shells are among the best in the world; while the prestige that accrued to us from our invention and manufacture of Harveyized armor will remain to our credit as long as armor-plate manufacture endures.

Although, as the Report suggests, no striking developments have occurred in the improvement of guns and armor, there has been satisfactory progress all along the line, and the manufacture of material has fully kept pace with the demand for it. The most interesting of the new guns just now is the 7-inch, 45-caliber piece, twelve of which are to form the secondary battery of each of our two great battleships "Louisiana" and "Connecticut." This gun, designed for a muzzle velocity of 2,900 foot-seconds within a limit of chamber pressure of 17 tons per square inch, has developed a muzzle velocity of 3,035 foot-seconds with a chamber pressure of only 16 1-3 tons, a most creditable result, not equaled or excelled by any gun of the same class. It is interesting to learn that the Bureau has recently ordered the manufacture of a 6-inch, 50-caliber gun to weigh about 8 tons, from which a muzzle velocity of 3,400 to 3,500 foot-seconds is expected with a 100-pound projectile. It is gratifying to know that the work of converting the old gravity-return mounts of the 6-inch guns of our earlier cruisers is being carried on, and that, shortly, practically all of the guns of this class will have the increased rate of fire and additional handiness due to reconversion. The "Baltimore," which has been undergoing reconstruction and refitting at the New York Navy Yard, is being rearmed with 6-inch, 45-caliber guns, and a similar change is to be made on the "Newark." The British-built cruisers "New Orleans" and "Albany" are to have their Armstrong guns replaced by 5-inch, 50-caliber, rapid-fire guns of American make, chiefly for the purpose of securing uniformity of guns and ammunition.

During the past year 7,612 tons of armor have been delivered at the various shipyards. The Report states that no improvement worth speaking of seems to have been made of late in the quality of the armor; a matter of regret, since guns, powder and projectiles have each made a decided advance. Rear-Admiral O'Neil draws attention at considerable length to the fact that the charge of delay in warship construction, due to the non-delivery of armor, has been pressed too far, and he shows that in the case of several of our ships the contract for armor was let many months after the contract for the ships, while in several cases the armor was delivered a year or so before the final completion of the vessel. Thus the "Illinois" was completed in September, 1901, her last armor plate having been delivered August 31, 1900, that is, a year before the final completion of the vessel; moreover, it was placed on the ship October 31, 1900, ten months before the vessel was in all respects completed. In the matter of powder, we learn that with the exception of ignition and shell powder, no black or other than smokeless powder has been purchased or manufactured for the Navy since the Spanish war. As regards the quality of our smokeless powder, we are told that so far as stability is concerned, the results have been most satisfactory.

The public will be greatly interested to learn that the question of improving the warships "Oregon," "Indiana" and "Massachusetts" by taking out their heavy and cumbersome 13-inch gun turrets and substituting electrically-operated balanced 13-inch turrets, and of otherwise improving them, has been under consideration on several occasions. We are of the opinion that this change could be made to very great advantage, for as coast defense vessels these ships will doubtless remain for several decades upon the active list of our Navy. Reference is made in the Report to the new armored cruisers of the "Tennessee" class, of 15,400 tons displacement, over which an earnest controversy was waged on the question of whether to give them 22 or 23 knots speed. Admiral O'Neil states that to give them a knot more speed, or the same speed as that of the British cruisers "Good Hope," "King Alfred" class, would call for machinery which would weigh 379 tons, or the weight of four 10-inch guns, mounts and turrets; even a quarter of a knot would represent the weight of an additional 2 inches of armor over the whole protective deck. As to artillery, the Chief of the Bureau considers that a higher stage of efficiency will be reached in the future than we have gained to-day. Stronger guns of better material, admitting of higher pressures, these pressures obtained probably with smaller charges and quicker powders, are among the possibilities that offer an interesting field of investigation. While a chamber pressure of 15 tons per square inch was until recently considered the maximum pressure that could be safely allowed, we have now a pressure of 17 and 18 tons, and guns designed for working pressures of 20 tons per square inch will soon follow.

CRITICISM OF THE NEW EAST RIVER BRIDGE.

In a recent issue of the New York Sun there appeared a letter from an engineer who was on the staff of the Forth Bridge during the erection of that famous structure, in which the writer, after paying a well-deserved compliment to the bravery of the city Fire Department at the East River Bridge fire, passes on to a general criticism of the careless management which rendered a fire possible, and of the great delay in the completion of the bridge, and closes with an attack upon the general design of the East River Bridge as such, alleging that it is erected on "antiquated and discarded engineering practice." The writer of the letter in question announces himself in his opening sentence as having been one of the staff of engineers that built the Forth Bridge, and he would have us believe that New York city is engaged in the construction of a great municipal work which is wrong in theory, poor in construction, and doomed to early decay. The somber hue of his reflections is evidently deepened by the fact that he was associated with the construction of a bridge which, according to his convictions, is the only type that is recognized by good engineering practice, or that the all-destroying hand of time will spare.

The SCIENTIFIC AMERICAN would scarcely have given attention to the letter, were it not that the writer of the letter admits that he was driven to utter his word of warning by an article which appeared in our journal so far back as August, 1897. The article in question contained a detailed description of the bridge, in which, by way of emphasizing its vast proportions, a comparison was made with the great Forth Bridge, which, while greater in its total length and longer in each of its main spans by 110 feet, does not possess any single span that is comparable in its width of suspended roadway or in its vast carrying capacity with the main span of the new East River Bridge. The Forth Bridge was built to carry two lines of railroad track, and permit the running of heavy express trains at their highest speed. This it has proved well able to do, and so far as its proving a link in a great railroad system, over which express trains may run at high speed, is concerned, the Forth Bridge is an admirable piece of engineering. But the carrying of two tracks of railroad is a very simple matter compared with the carrying of six railroad tracks, two of them for the steam cars of the elevated railroad system, and four of them for our heavy, modern electric cars, to say nothing of two 20-foot roadways for heavy city traffic, two footways for passengers, and two bicycle tracks, the whole suspended floor system having a total width of 120 feet. Any single span of the Forth Bridge, compared as to width of floor and carrying capacity with the single span of the East River Bridge, is of very modest capacity.

Our critic next proceeds unwittingly to censure the work of himself and his *confrères* on the Forth Bridge, by saying that, given the necessary platforms and floors, the Forth Bridge could carry, in addition to its present work, the whole traffic of the Brooklyn Bridge without appreciable fatigue. If this is the case, there must have been built into the Forth Bridge some thousands of tons of material which was absolutely unnecessary. We had heard it stated that after completing their calculations for a bridge, English engineers were in the habit of throwing in a whole lot of additional material, merely to be sure that it was "perfectly strong enough;" but not until the fact was so frankly admitted by this correspondent, did we believe that this was anything more than one of the stock jokes of the profession. Now, the American engineer believes that in designing a bridge the first thing to ascertain is the exact amount of duty required of it; and secondly, to select the materials and so dispose them that this duty shall be performed with the use of the least possible amount of steel, disposed in the best possible way for utilizing its compressive and tensile strength. It was in accordance with these principles that the East River Bridge engineers decided to use the suspension in preference to the cantilever principles of construction. For the suspension bridge permits the use of steel wire, the very strongest form of steel known to our modern industries; whereas the cantilever form necessitates the use of a mild steel, whose strength is only about 30 per cent of that of steel wire. Strange to say, the Sun's correspondent is so wrapped up in the conservatism which is so frequently charged against English engineers, that he does not hesitate to commit himself in his letter to the following extraordinary statement: "It is a remarkable fact that . . . a new bridge should have been designed and partly erected on antiquated and discarded engineering practice;" referring, of course, to the use of the steel wire suspension bridge in preference to the cantilever adopted in the Forth Bridge. Now, as a matter of fact, before it was decided to build a suspension bridge, the whole question was very carefully thrashed out by our engineers, and the cantilever form was rejected at once as being altogether too heavy and costly for a span of this magnitude. Our practice, in this country, is to use plate-steel, riveted girders on bridges up to 175-foot spans; riveted or pin-connected trusses for from 175 up to 500-foot spans, cantilevers for from 500 to 1,000 or 1,200-foot spans, and steel wire suspension bridges for everything above that. While it is true that in the smaller suspension railroad bridges the problem of rigidity of floor system is a difficult one to satisfactorily solve, in spans of over 1,200 feet the great mass of the floor system as compared with the moving loads, and the depth of the stiffening trusses, are such that the rigidity of the floor system can be completely assured; and with a perfectly rigid floor system the steel-wire suspension bridge is from every point of view the ideal, and in fact is the only practicable form of bridge that can be used.

The cantilever which our Forth Bridge engineer would have us substitute is so enormously costly and clumsy that the engineer who would use it in America to-day would be, to borrow the phrase of our critic, guilty of "antiquated and discarded engineering practice." To give a few concrete figures as evidence, we quote the results arrived at by a board of engineers appointed a few years ago to make an estimate for a bridge of 3,100-foot span across the Hudson River. This board, which included such eminent men as Messrs. Burr, Cooper and Morison, found that while a suspension bridge would cost $35,367,000, a cantilever bridge of the same capacity would cost not less than $51,128,000, a cost which the Commission very promptly set down as prohibitive.

The great Forth Bridge, with its two spans of 1,710 feet, is a monumental structure which, when we bear in mind the absence of any precedent at the time of its design, some twenty years ago, for a work of such magnitude, reflects the greatest credit upon the courage and resourcefulness of its engineers. At the same time, the "boilershop methods" adopted in its construction would never be used in American practice; for the tubular sections adopted for the compression members involved an enormous amount of labor which could have been avoided by the use of rectangular sections, with which the same strength of structure and a more harmonious effect could have been secured. Of course, at the time of its erection, the Forth Bridge engineers did not have at their command steel with a tensile strength of 223,000 pounds to the square inch, which was the load under which the test wires used in the Brooklyn Bridge cables broke when tested. With such wires in the cable, and with these cables thoroughly saturated with a waterproof composition, wrapped with a triple layer of canvas and an outer covering of steel plate, and the whole carefully painted from year to year, there is no reason why the Brooklyn Bridge cables should not live as long as the Pyramids themselves.

A 200 HORSE POWER MOTOR-PROPELLED BOAT.

M. Emile Altazin is constructing a boat which is to use a 200 horse power gasoline motor. The vessel, which is a fishing boat, will also be provided with sails; it is being built at Boulogne, France, and will be tried next year. Up to the present gasoline motors of over 80 horse power have not been used on boats, and the experiment will therefore be of interest. The boat is 90 feet long, 26 feet wide, and the maximum draft is 14 feet. It is to be used for herring and mackerel fishing with nets, and can carry a load of 250 to 300 tons. On the fishing trip it is to take on board 330 nets, 900 barrels for receiving the fish, 800 boxes for placing the fish on ice, etc. It will also carry 65,000 pounds of ice and the same quantity of salt. Tanks are to be provided

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having a capacity of 8,000 gallons of gasoline or alcohol for the motor. Besides the 200 horse power motor for driving the propeller, there will be a small 25 horse power motor to operate the capstan and for raising and lowering the nets. The large motor has four cylinders of 50 horse power each, and the smaller one two cylinders. The mechanism is arranged so that the small motor can be coupled to the larger, and thus add its power if need be. Both motors work at 300 revolutions per minute and have governors which may be controlled either from the engine room or the deck so as to vary the speed at will. The combustible to be used is either ordinary gasoline or pure alcohol without the usual mixture with gasoline. The carbureter is designed to work equally well with either. As the nets, when they are lowered, might become caught in the propeller, the latter is provided with a sliding covering which may be run down along a guide support and thus be partly inclosed.

THE HEAVENS IN DECEMBER.

BY HENRY NORRIS RUSSELL, PH.D.

The finest region in all the starry heavens now occupies the eastern sky. In one-tenth of the total area of the visible heavens it includes eight out of the sixteen brightest stars visible in our latitude. As we turn our gaze eastward at our customary hour of 9 o'clock on December 15, we find near the horizon the two dog-stars, Sirius and Procyon. The latter is nearly due east, and is somewhat higher up than the former, which, even at its present low altitude, gives evidence of its surpassing brightness. Both these stars are among our near neighbors in space, and both are attended by faint companions, visible only with the largest telescope.

Above Sirius is Orion, with the bright red star Betelgeuse on the left, and the still more brilliant Rigel lower down on the right. Gemini, which lies above Procyon, has also a pair of bright stars. The upper one is named Castor, and the lower Pollux. Still higher up are Auriga (above Gemini) and Taurus (above Orion) bearing the bright stars Capella and Aldebaran.

The long line of faint stars which begins at Rigel and can be traced westward, then southward, and then back toward the southeast, forms the constellation Eridanus. Its one bright star, Achernar, which nearly equals Rigel, can be seen at this season low on the southern horizon from places south of latitude 32 deg. The large constellation of Cetus, the Whale, occupies a great part of the southern sky. The monster's head is marked by an irregular pentagon of small stars, which is now on the meridian, about half way up to the zenith. The brightest star in the constellation, Beta Ceti, lies nearly 40 deg. to the westward, and is the only conspicuous one in the southwestern sky.

Aries is nearly on the meridian above Cetus, and Perseus is directly overhead. Observable minima of Algol will occur on the 12th at 11 P. M., on the 15th at 8 P. M., and on the 18th at 5 P. M. Andromeda and Pegasus are the most conspicuous constellations to the west of the zenith, Cygnus is still visible in the northwest and Lyra is low on the horizon. Ursa Minor and Draco are below the pole, Ursa Major coming up to the east of it, and Cassiopeia and Cepheus high on the west.

We have had some occasion in the foregoing to refer to the distances of certain stars. Nothing in all the realm of astronomy impresses the imagination more than these enormous distances. Indeed, they are so vast that it is hardly credible that they can be measured at all.

The principle used by astronomers to determine them is exactly that of the range-finder employed by modern gunners. Bearings are taken on the distant target from two points as far apart as is practicable. Knowing the distance between these points, the distance of the target can be calculated from the difference of its bearing at the two points.

When we come to apply this method to the stars, we find that the whole diameter of the earth is far too short a base-line. Fortunately, we have a longer one available, the diameter of the earth's orbit. By taking observation of a star at properly chosen dates six months apart, we have a base 186,000,000 miles long, and can proceed with some chance of success.

The next question is: How can we measure the bearing of the star with sufficient accuracy? The best way is to choose some small stars near the one to be investigated, and use them as points of reference. Such small stars are usually so far away that their change of bearing may be neglected, while the nearer star appears to be slightly displaced with reference to them. Occasionally the faint star chosen is no farther off than the other, or even nearer. This is the case with Rigel, which has a ninth magnitude star close to it. The measures showed that the faint star, far from being behind the other, was actually the nearer of the two. But by choosing several small stars and measuring from them all, this source of error can be pretty well done away with.

The whole observed change of bearing of the star is evidently equal to the angular diameter of the earth's orbit, as seen from the star. Half of this, or the radius of the earth's orbit, as seen from the star, is called its parallax. The nearer a star is the greater its parallax will be.

By the methods outlined above, the distances of a considerable number of stars have been measured. The nearest one is Alpha Centauri (invisible in our latitude) whose parallax is three-quarters of a second of arc, corresponding to a distance 275,000 times as great as the sun's.

The most convenient unit for measuring these great distances is the *light-year*—the distance light travels in a year. This is about 63,000 times the sun's distance, so that if we made a map on such a scale that the earth was one inch from the sun, a light-year would be represented on the map by one *mile*.

Alpha Centauri is a little over four light-years distant. Sirius, whose parallax is half as great (0.37 sec.) is twice as far away.

If a star is over 100 light-years distant, its parallax is too small to be measured, and we must remain ignorant of its true distance. This is the case for some of the very brightest stars, and for the vast majority of the remainder. For example, all the conspicuous stars in Orion have no sensible parallax. All we can say is that they must be many times as far away as Sirius or Procyon—how many times we do not know. But it follows that they must be really much brighter than Sirius, which if transported to so great a distance would at best be inconspicuous to the naked eye.

THE PLANETS.

Mercury is morning star until the 12th, but evening star before his passage through superior conjunction on that date. He is too near the sun to be seen.

Venus is evening star, and is also very near the sun, though she may perhaps be visible at the end of the month, when she sets half an hour after sunset.

Mars is morning star in Virgo, and is now rapidly gaining brightness. On the 22d he is in quadrature with the sun, and crosses the meridian at 6 A. M. He is at his greatest phase, and appears through the telescope like the moon three days from the full.

Jupiter is evening star in Capricornus, setting about 8:30 P. M.

Saturn is evening star in Sagittarius, setting at about 7 P. M.

Uranus is in conjunction with the sun on the 14th, and is invisible.

Neptune is in opposition on the 24th. His position on the 1st is in right ascension 6 h. 12 m. 40 s., and declination 22 deg. 16 min. 25 sec. north, while on the 31st it is right ascension 6 h. 9 m. 7 s., and declination 22 deg. 17 min. 27 sec. north. He can be seen with a small telescope, though it takes a large one to show his disk. His green color will aid in finding him, though he can only be certainly identified by his motion.

THE MOON.

First quarter occurs at 1 A. M. on the 8th, full moon at 11 P. M. on the 14th, last quarter at 2 P. M. on the 21st, and new moon at 4 P. M. on the 29th. The moon is nearest us on the 15th, and farthest away on the 2d, and again on the 29th. She is in conjunction with Saturn on the 3d, Jupiter on the 5th, Neptune on the 15th, Mars on the 21st, Uranus on the 28th, and Venus and Mercury on the 30th. On the 13th she occults the fourth magnitude star Delta Tauri, and two smaller ones near it. The occultation lasts from 6:55 to 7:59 P. M., as seen from Washington, and should be interesting to watch with a glass.

At 1 P. M. on the 22d the sun reaches its greatest southern declination, and enters the sign of Capricorn, and, according to the almanacs, "Winter commences."

THE NATIONAL ACADEMY OF SCIENCES.

BY MARCUS BENJAMIN, PH.D.

The Scientific Session, as the autumn meeting is called, of the National Academy of Sciences, was held in the Physical Laboratory of the Johns Hopkins University in Baltimore, on November 11 and 12, 1902. Fifteen papers were presented before the Academy, several of which were of considerable importance, and a brief abstract of these is herewith given.

Under the title of "On Elevated Oceanic Islands in the Pacific," Dr. Alexander Agassiz continued a description of the results of his interesting researches into the character of two of the islands of the Fiji group made by him some years since while cruising on the U. S. Fish Commission steamer "Albatross."

Dr. Lewis Boss, Director of the Dudley Observatory, in Albany, N. Y., read a technical paper on "A New System of Positions for Standard Stars, with Notes Relative to its Bearing upon Sidereal Astronomy," and a short biological contribution on "The Embryology of Salpa Cordiformis" was presented by Prof. William K. Brooks, of the Johns Hopkins University.

"The Spectra of Stars of Secchi's Fourth Type," by Prof. George E. Hale, of the Yerkes Observatory and the University of Chicago, was the first paper read before the Academy. It is too technical, however, for abstraction here.

A series of papers by non-members introduced by Prof. Ira Remsen, President of the Johns Hopkins University, were read, and of these "The Preparation of Cells for the Measurement of Osmotic Pressure," by Prof. Harmon N. Morse, called attention to the fact that our knowledge of osmotic pressure has been very defective, because of the lack of an experimental basis for it. It has been seventeen years since Van't Hoff told us that osmotic pressure obeys the same laws as those for the pressure of gases. Since this principle was enunciated not more than half a dozen quantitative experiments in this field have been undertaken. Prof. Morse then explained the results which he had obtained from his studies, and showed cells which he had made himself, and which gave a higher osmotic pressure than has as yet been obtained by anyone in the world.

Prof. Robert W. Wood, who succeeded to the chair of physics in the Johns Hopkins University on the death of Henry A. Rowland, announced, under the title of "A Substance with Remarkable Optical Properties, and Screens Transparent only to Ultra-Violet Light," a discovery which is said to be of great value in science, and which was a notable personal triumph for Prof. Wood. He first described Tyndall's experiments with a screen that cut out all the visible rays of the spectrum, as well as the ultra-violet rays, and let through only heat rays. For the past thirty or forty years eminent physicists all over the world have been trying to find a similar screen that would cut out all the heat and all the visible rays and let through only the ultra-violet rays. Dr. Wood had for some time known that the substance called nitroso-dimethyl-aniline would keep out all the visible and heat rays, except some red and violet, and that it would also let through the ultra-violet. It has been only within the past few days that Dr. Wood has discovered the much-sought screen. He combined the known substance with cobalt glass and obtained a screen that lets through only ultra-violet. One striking peculiarity of the nitroso-dimethyl-aniline, which Dr. Wood dwelt upon and especially emphasized, is the fact that it gives a spectrum about thirty times as broad as that produced by ordinary quartz.

An exceedingly interesting communication on "The Occurrence of Reef Corals near Beaufort, North Carolina," by Dr. Caswell Grave, a non-member who was introduced by Prof. William K. Brooks, was then read. In introducing Dr. Grave, Prof. Brooks said: "Rocks are entirely absent from the coast of North Carolina. The natives use the word 'rock' to designate a bed of oysters. Notwithstanding this, however, I have observed along that coast for many years signs of animal life which seemed to indicate a rocky bottom not far away. Dr. Grave discovered last summer, twenty miles off the coast, what seems to be a coral reef." Dr. Grave then said: "The fishermen about Beaufort have long known of a spot over which, if they strike it just right, they can always fill their boats. In the ship "Fishhawk" we located this place about twenty miles off the Beaufort inlet, half way out toward the Gulf Stream. We dragged it thoroughly, and the many forms our dredges brought up resemble closely those from the coral reefs common farther south. Among other things, we found the corals themselves. Fishing with fifteen lines for the two hours it took us to drift across the reef, we caught seven hundred fish so large that they filled ten bushel baskets. No one could get a bite after we had drifted over the edge of the reef." In discussing this paper President Agassiz expressed the opinion that the bed found by Mr. Grave must be a spit or spur of the great Florida reef, which he and Prof. Shaler traced as far north as South Carolina and there lost.

A "Biographical Memoir of Henry A. Rowland" was presented before the Academy by Thomas C. Mendenhall. It will be recollected that Prof. Rowland was from the opening of the Johns Hopkins University until his death in 1901 in charge of the Physical Laboratory, and it was therefore especially fitting that this memoir should be read in the laboratory where he had so often lectured.

President Agassiz announced the deaths of the following members who had died since the last meeting: Henry Morton, President of the Stevens Institute of Technology, Hoboken, N. J.; John W. Powell, Director of the Bureau of American Ethnology, Washington, D. C., and Ogden Nicholas Rood, Professor of Physics in Columbia University, New York city.

The members were made the recipients of many social courtesies, President Gilman, of the Carnegie Institution, entertaining a number of them at dinner and at a public reception, and Profs. William H. Welch and William Osler giving the members of the Academy a dinner at the Maryland Club.

It is reported that H. W. Menke, of the Field Columbian Museum, Chicago, has discovered in Oklahoma the fossil remains of enormous amphibians. Some of the bones found are as large as those of a modern ox.

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THE AMERICAN HEMP INDUSTRY.

BY WALDON FAWCETT.

The recent expansion of the hemp industry in the United States entitles it to consideration as one of the most interesting of the nation's newer fields of activity. The hemp plant grows to a height of from five

PISTILLATE PLANT, SMYRNA TYPE.

to fifteen feet, and when cultivated for fiber produces only a few small branches near the top of the slender stalk. The leaves are of a rich dark green color, and the fiber consists of numerous series of long cells in the inner bark, firmly knit together, which, when cleaned from the surrounding tissues, form tough strands nearly as long as the entire plant. This is a bast fiber, and is classed commercially among the soft fibers, with flax, ramie and jute.

Hemp fiber is long, soft, very strong and capable of almost as fine subdivision as flax. It is especially adapted for use where strength is required. It is used in the manufacture of fine twines, carpet thread, carpet yarns, sailcloth and for homespun and similar grades of woven goods. Nearly all of the best grades of long-fiber—"dressed line"—is utilized for making twines and yacht cordage, while the cheaper grades are converted into binder twine. The tow is used for threads and for yarns to be woven into carpets, homespuns and linen goods, while the refuse fiber combed from the tow is used as oakum for calking ships. As indicating the possibilities of development for the domestic hemp industry, it may be noted that of the 18,000,000 pounds of hemp consumed annually in this country, only about 8,500,000 pounds are raised in the United States.

The great center of American hemp production is Kentucky, where in nine counties of the Blue Grass region three-fourths of the American hemp fiber is produced. About two hundred acres are devoted to hemp cultivation in Nebraska, and during the last half dozen years the industry has developed in several different sections of California. A foothold has also been gained on a small scale in Texas and Illinois. The remarkably successful cultivation of hemp in the Blue Grass region is to be attributed in a great measure to the presence of a yellow clay loam or rich sandy loam soil rather firm in texture and usually underlaid with a subsoil of yellow clay. In Nebraska hemp is cultivated on rich, black, friable prairie loam, comparatively loose and light in texture. In California the most favorable hemp lands are the alluvial soils in the bottom lands along the rivers.

It is sometimes the practice in Kentucky to have hemp follow hemp on the same land for two or three years, but as a rule it is preferred to cultivate a series of crops in rotation. In California and Nebraska no crop rotation is practised for hemp. In hemp cultivation the best results are usually secured from deep fall plowing, followed by thorough harrowing in the spring. The seed is usually sown in the spring, at about the time for sowing oats, the season in Kentucky being from the middle of March to the last of April; in Nebraska, from April to June; and in California, in February and March. One of the chief aims of the hemp grower is to secure an even stand of plants, uniform in size, for it is well-nigh impossible to make good fiber from a mixture of stalks of various sizes.

Naturally the harvesting of the hemp is an important operation. The hemp is cut when the staminate plants are in flower, and the time of harvest therefore varies from eighty to one hundred and forty days from the date of seeding, the period of growth being dependent on the mean temperature and the supply of moisture. In Kentucky the harvesting usually occurs in August or September, and in California and Texas in July. On the Pacific Coast the hemp is cut with self-rake reapers or mowing machines. In Nebraska the self-rake reapers have almost entirely displaced the mowing machines. In Kentucky reapers have been introduced of late years, but the major portion of the crop is still cut by hand by means of the primitive reaping knife or hemp cutter, which has some of the characteristics of both the corn cutter and bush scythe.

An experienced workman with a reaping knife will cut the hemp from a tract of about half an acre in a day. With a sweep-rake reaper under the most favorable conditions from five to seven acres may be cut in a day, and with a mowing machine the daily cut ranges from seven to ten acres. After the hemp is cut it is allowed to lie on the ground from four to eight days to dry, and the unbound bundles are usually turned so as to dry both sides. When thoroughly dry the hemp is bound in small bundles with cheap twine or small hemp stalks, and stacked or set up in shocks. If the stacks are properly built the hemp will remain in this position, uninjured, for a period of two or three years, and furthermore the quality of the fiber is improved and the breaking and cleaning rendered easier by a process of sweating or fermentation which the stalks undergo when in stack.

An essential process of hemp production is the retting or rotting, whereby the vegetable gums surrounding the fiber are dissolved and the fiber at the same time freed somewhat from the woody interior portion of the stalk and also from the thin outer cuticle. These gums are not soluble in water, but are destroyed by a kind of putrefaction which takes place when the stalks are immersed for some time in soft water or are exposed to the weather. Retting by immersing the stalks in water is largely practised in France and Italy, but nearly all of the hemp now produced in the United States is dew-retted; that is, spread in long rows on the ground during the fall and early winter, and exposed to the weather until the bark, including the fiber, readily slips from the inner woody portion. In Kentucky the hemp must, in many instances, be hauled two or three miles from the harvest field to the retting grounds. Retting in Kentucky is carried on during the month of November.

After the hemp has been retted sufficiently to enable the ready separation of the fiber there comes the breaking, by which the fiber is separated from the stalk and roughly cleaned. This is the final operation which falls to the lot of the hemp grower, as the hemp is, by this means, prepared for market as rough hemp. Nearly all the hemp is broken by hand breaks, but with one of the crude, heavy, wooden breaks an experienced operative can readily clean about 250 pounds a day. The work is performed by alternately crushing or breaking the stalks between the long jaws of the break, and beating and whipping them over the break to free the coarse part or hurds from the fiber. It is a slow process, requiring skill as well as strength, but the wage usually paid is only one cent a pound. To break an average crop of fifty acres requires the services of ten skilled hemp breakers for two months and entails an expense of about $500. This excessive expenditure of time and money has been largely instrumental during late years in forcing the hand break to give way to machinery, of which several types are already in the market.

In Nebraska and California there is in use a machine consisting of a series of coarsely fluted rollers followed by a rapidly revolving spiked cylinder, which breaks hemp and delivers the fiber in the form of tow. In the hemp factories at Lexington, Ky., are machines consisting of long series of corrugated rollers which are occasionally used for softening the fiber Last season saw the operation in Kentucky, for the first time, of three decorticators, in which the hemp stalk is crushed in passing between rollers, corrugated for unretted hemp and smooth for retted. The hurds are then loosened by a rapidly vibrating mechanism, and the fiber is partly cleaned by a kind of carrier which gives a rapid scraping motion. These machines weigh

KENTUCKY HEMP, HALF GROWN.

only about one ton each and require but six horse power for their operation. The average daily output of a machine is 2,000 to 3,000 pounds of rough hemp.

In some instances hemp is disposed of by the growers direct to the manufacturers, but in most cases the rough hemp fiber is tied in bales weighing about 150 pounds each and sold to dealers in the local markets. Under fair average conditions an acre of hemp yields about 1,000 pounds of rough fiber or about 6,000 pounds of dry retted stalks. At five cents per pound for the fiber it is a very good paying crop, and the minimum limit of profitable production is regarded as about 3¼ cents per pound.

CUTTING HEMP.

Tools which are for any reason superannuated or not up to the standard of modern requirements are ruthlessly discarded in American shops, no matter what they cost, or how short a time they have been in service. A case in point is the enormous steam hammer at the Bethlehem Iron Works which was, and still is, a monster in its class. It is over 90 feet from top to bottom, and is 38 feet square on the base.

The weight of the striking parts is 120 tons, and the steam pressure 120 pounds per square inch. The steam cylinder is 76 inches in diameter, and the stroke nearly twenty feet. The hammer is being demolished, notwithstanding that it has only been in existence 11 years. Hydraulic squeezing presses have been found far more efficacious for reducing large ingots, inasmuch as the stress penetrates to the center, while the hammer-blow is comparatively superficial. The cost of this tool must have been very great, but it had to go, and so was ordered demolished in spite of its cost.

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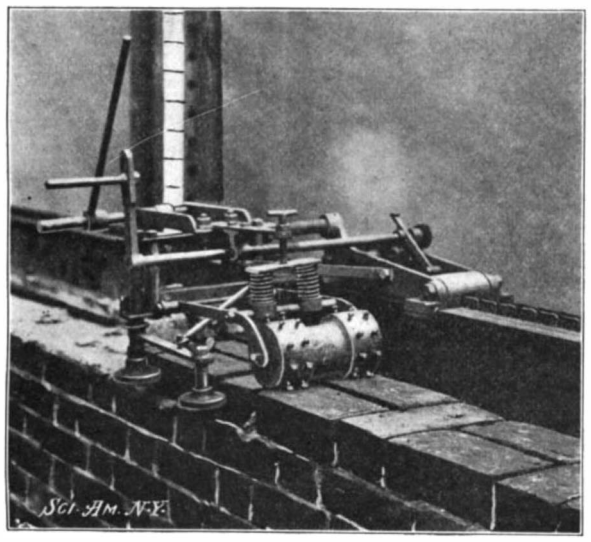
A MACHINE FOR LAYING BRICKS.

A machine which is intended for plain bricklaying, such as walls and the like, is an invention which must be credited to the ingenuity of an Englishman, Mr. John H. Knight, of Barfield, Farnham.

Vertical posts, *A*, are set in the ground about 15 feet apart, adjacent to the wall to be built. To these



A BRICKLAYING MACHINE.

posts a wooden girder *B* is secured upon which a 6-inch by ¼-inch steel plate *C* is screwed. Upon the bed thus formed the machine itself runs. The driving mechanism consists of a toothed pinion meshing with a pitched chain along the girder, motion being given to the pinion by the gears *E* and the handle *F*. A guide bar *G* secured to the girder forms a straight-edge for the face of the bricks, which are fed to the machine by hand. A pawl *M*, operated by the handle *N*, serves to press one brick back against the previous brick. Each brick, as it moves back, pushes a ridge of mortar in front of it, so that the vertical joint between the two bricks is filled up. Guide wheels *HH'* press the bricks against the straight-edge. A bricklayer usually pats the top of each brick with his trowel; this mechanical bricklayer does the same. A spiked roller *J* performs this slight task, the desired amount of pressure being imparted by a stout spiral spring *S*, and adjusting screws.

The mortar is run out by hand in front of the machine. After each course of bricks has been laid, the girder on which an operator performs is lifted by hand three inches. Holes are bored in the posts to form catches for a lifting lever. Two men and a boy can operate the machine. One man spreads the mortar, the second feeds the machine, and the third operates it. Mr. Knight informs us that anyone can operate the machine. He claims for it an ability to lay 500 to 600 bricks per hour.

OFFICIAL TRIALS OF OUR SUBMARINE BOATS.

The "Adder" and the "Moccasin," two of the six submarine boats which are being constructed for the navy, have recently been undergoing their trials, with results that have been very gratifying both to the builders and to the Naval Board of Inspection, for whose benefit the trials have been carried on. The vessels are the "Adder," "Grampus," "Moccasin," "Pike," "Porpoise" and "Shark." They are all identical in size, construction, and equipment. They were designed to be an improvement upon the "Holland," which was the first torpedo boat owned by the navy, and in them is incorporated the valuable experience which has been gained in a long series of experiments with the pioneer vessel. The "Holland" is 53 feet 11 inches long, 10 feet 3 inches extreme diameter, and displaces 74 tons. As her armament she carries a torpedo tube and a so-called dynamite gun. The improved "Hollands," of which the "Adder," herewith illustrated, is one, were authorized on June 7, 1900. They are 63 feet 4 inches in length, 11 feet 9 inches in diameter, and they displace, when submerged, 120 tons. When running on the surface they are driven by a single-screw, four-cylinder gasoline engine of 160 horse power. They also carry a 70 horse power generator, which may be driven by the gasoline engine for the purpose of charging the batteries when the boat is at the surface, and when the boat is submerged it can be connected with the batteries and used as a motor for driving the propeller. Like all vessels of her class, the "Adder" is constructed with a double bottom and two transverse bulkheads, dividing her into three watertight compartments. The gasoline tank, the expulsion tube and the air flasks for the torpedoes are carried in the forward compartment; the center compartment holds the main ballast tanks, the cellular structure of the double bottom being used for the latter purpose, while above the ballast tanks are carried the storage batteries, the torpedoes and the air flasks, in which fresh air for living purposes is stored at a pressure of 2,000 pounds to the square inch. The third compartment, in the stern of the boat, contains the gasoline engine, the motor and the steering gear. To submerge the vessel, water is admitted to the trimming tanks, and a pair of horizontal rudders at the stern are inclined so as to depress the nose of the boat and cause her to descend. The vessel is controlled from the conning tower, which will be noticed above the working platform. It is protected from the rapid-fire guns of the enemy by the four inches of Krupp steel with which the conning tower is clothed.

In the recent official trials by the government Board of Inspection and Survey, the "Moccasin" and the "Adder" both achieved speed results considerably above those called for by the contract. The "Adder" made an average speed on the surface of 8.5 knots an hour when running in the light condition, that is with all her submersion tanks empty. In the awash condition she made an average speed of 8 knots an hour, and when totally submerged her speed was 7.5 knots, and thereby she exceeded her contract speeds

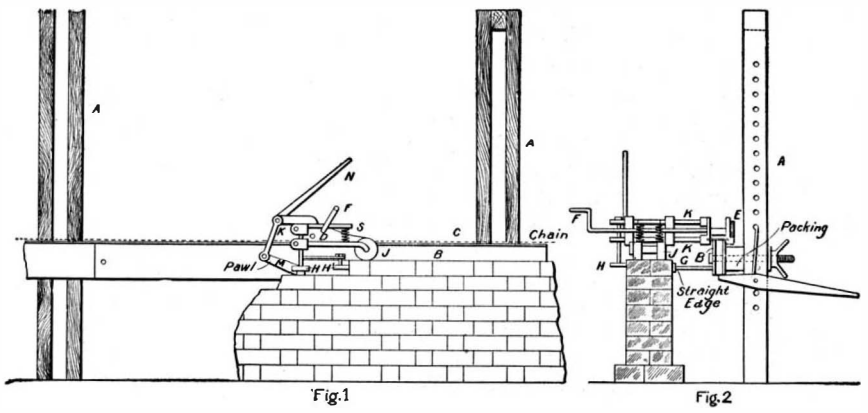
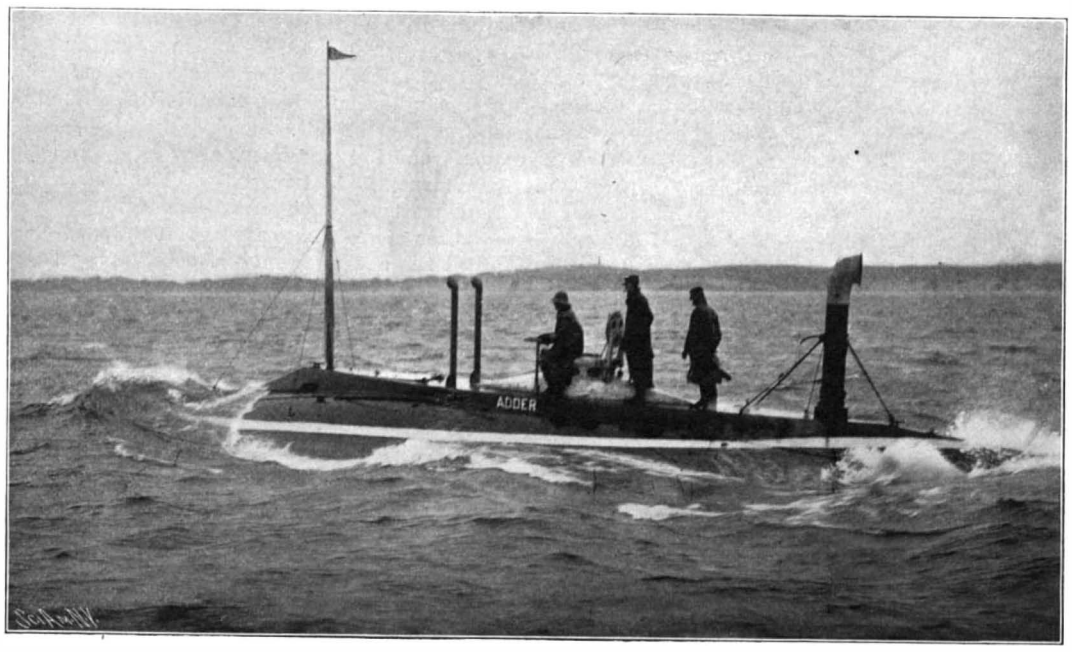
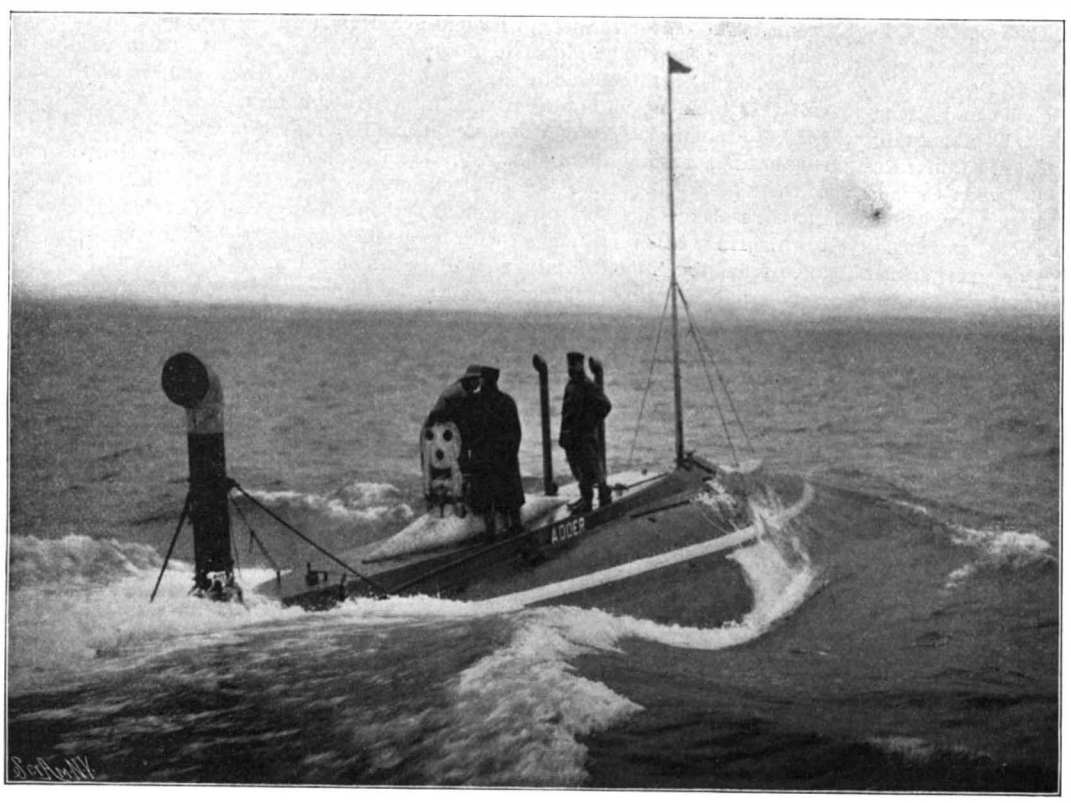


DIAGRAM OF THE BRICKLAYING MACHINE.

by half a knot on the surface, by one knot when awash and by one-half a knot when completely submerged. In her trial on November 18, the "Adder," after taking position on the course and getting under way, ran for a mile submerged, then turned and returned to the starting point and fired her torpedo at a predetermined mark. The turn was made when she was completely submerged, and in the home run only two observations, lasting 30 seconds each, were taken, one of them soon after the turn, and the other between the half and the quarter mile flags. After the second observation she remained invisible, with no indication of her whereabouts, except when she fired her torpedo, the course of the torpedo being indicated, as it always is, by the trail of bubbles of compressed air from her engine rising to the surface. The torpedo went a few feet wide of the mark, although it was claimed that the divergence was due to the swerving of the torpedo and not to faulty aiming from the "Adder." The whole run submerged occupied a period of three hours, and according to press reports, Naval Constructor Woodward, one of the officers of the Inspection Board, stated that the air, excepting during the last twenty minutes of the run, was perfectly fresh, and even in the latter period it was as fresh as the air on the berth deck of a battleship. Subsequently the engines were tested satisfactorily on a continuous run of 12 hours duration. There is no question that the results achieved in these trials have done much to advance the submarine boat in the opinion of army and navy men. It is considered in army circles that the possession of a few of these boats would greatly strengthen the defenses of any important harbor or shipping port. That increased attention has been directed to the submarine is shown by the presence of a specially constituted Army Board to observe the trials and report upon them to the War Department.



BROADSIDE VIEW OF THE "ADDER," SHOWING WAVE FORMATION.



THE SUBMARINE "ADDER" MAKING HER OFFICIAL SURFACE RUN AT 8.5 KNOTS AN HOUR.

To make a small cork fit a large bottle, and *vice versa,* it is common practice to trim the sides of a cork when it is too large for a bottle. Generally the knife is dull, and the cut irregular. A simpler way is to cut a wedge-shaped piece out of the cork at its lower end. If the cork is very large, cut out an additional wedge at right angles to the first. This will make a perfect non-spilling stopper.

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Vice Versa, if the cork is too small, cut off a transverse section from its lower end, make a deep vertical slit in the top of the cork, and wedge in the disk without trimming. The cork will now fit tightly in a bottle otherwise much too large, and may be properly trimmed. The thickness of the disk is proportionate to the difference between the diameters of the cork and mouth of the bottle.—W. Lawrence Stevenson, M.D.

THE NEW BEACHY HEAD LIGHTHOUSE.

The new lighthouse off Beachy Head, on the English Channel, is now completed. It has been erected by the Corporation of Trinity House, the body responsible for the lighting of English waterways. It has been built at a cost of $100,000, and represents the latest example of the sea-builder's skill, as the engineers who build these structures are called.

As the undertaking has already been described in the SCIENTIFIC AMERICAN of November 9, 1901, anything like a detailed reference to the new light is unnecessary. It is situated on the foreshore, some 550 feet from the toe of the great cliffs. At high tide the surrounding site is covered to a considerable depth, which naturally made the work difficult and progress slow, particularly during the winter months. Indeed, work was commenced on the site so far back as July, 1899. The foundation is laid to a depth of 10 feet in the hard chalk. As no blasting was allowed, the foundation had to be dug out by pick and ax. This work had often to be suspended for days at a time through rough weather. Fortunately, no serious accidents have occurred, considering the nature of the enterprise, one man having lost a toe while endeavoring to place a stone in position. Several tools were washed away, though the majority were eventually recovered.

At the base the structure has a diameter of 47 feet and is perfectly solid for a height of about 48 feet, with the exception of a space reserved for the storage of water. It is built of granite, which came from the Hard Stone Firms' quarries at De Lank, Cornwall. Altogether, some 3,660 tons of granite were used in its construction. The tower boasts of seventy-six courses. Up to the twenty-sixth course they have a depth of 4 feet 10 inches, many of the stones weighing 4½ to 5 tons. To the top of the masonry the new tower measures 123½ feet, while to the top of the lantern it has a total height of about 153 feet.

The lighthouse has eight rooms. They commence at course No. 26, termed the entrance-room. Then come the oil-room, crane-room, store-room, living-room, bedrooms and service-room. The lantern is equipped with a dioptric apparatus, giving flashes of about 83,000 candle power intensity every fifteen seconds. The illuminant is mineral oil converted into vapor passed through a Bunsen burner. The flashes are controlled by clockwork, which is wound by hand, the weight rising and falling in a tube in the center of the tower. The apparatus rotates in a mercury trough.

The new light is almost double the power of the one it displaces on the famous promontory above the shore. There were two reasons why the erection of a new lighthouse at this spot became necessary. In the first place, the old light, which stood 400 feet above the level of the sea, was frequently capped by fog, while the encroachments of the sea rendered it unsafe. There have been several large "falls" at Beachy Head during the last decade. It is estimated that in 1893 some 85,000 tons of earth and cliffs were dislodged, while a similar catastrophe in 1896 brought down a mass calculated to weigh 89,000 tons.

The English Pacific Cable.

The much-talked-of, much-obstructed and long-delayed Anglo-Pacific cable has at last been actually opened for the transmission of messages. Congratulations were exchanged on October 31 between Canada and Australia over the new line. The London Times in commenting editorially on this new enterprise states that its history is the history of every great undertaking, the history of patient effort by a few energetic and farseeing men fighting the obstacles of official dullness, public apathy and vested interests.

This new cable brings the Australasian colonies ten thousand miles nearer to Canada than they were before, and at the same time opens up possibilities of other substantial improvements in imperial communications. Across the Pacific, from Vancouver to Queensland, the cable touches only British territory; and now there is completed a telegraph girdle of the world which touches foreign territory only at Madeira and St. Vincent, in the Cape Verde Islands, both belonging to an old ally, Portugal. Thus the empire is bound together by what is all but an all-British line, giving an alternative means of communication free from the grave dangers which at critical moments would threaten connection with the colonies by the previously existing route. The new route will have a further great advantage in speed, since it has only three transmissions across the Pacific, all on British soil, in place of over a dozen belonging to various nationalities. Its tariff will be less than half that of the other route prior to reductions which are directly due to its competition. There is no reason to doubt that it will be fully employed, nor any reason to fear that it will do any harm to established companies. The reductions in their rates which nothing else would have induced them to make have been balanced by an increase of business, and further reductions would undoubtedly lead in the present conditions of the world to a yet greater increase of public patronage. The commercial use of the long-distance cables has been terribly hampered by almost prohibitive rates, and the social use of them can hardly be said to exist. There is indefinite expansion to be looked for in both directions, proportioned to the facilities that can be obtained at reasonable charges.

Having regard to the military and naval advantages obviously accruing from an alternative line of communication with distant portions of the empire, especially when that line is independent of all foreign territory, it is something of a satire upon British imperial professions that it has only now been secured through the colonies rather than through the home government. Even in the latest stages of the struggle for the Pacific cable, the haggling of the mother country about her share of responsibility for a possible deficit does not form a very inspiring chapter of history. It was only under considerable pressure from public opinion that England finally became responsible for five-eighteenths of the cost of the cable. To extend the benefit of an alternative and all-British route to India, where strategic considerations are surely important enough, it is still necessary to construct a line from the Cocos Islands to Ceylon. From the commercial point of view it is surely something of a scandal that, until the construction of the Pacific cable was assured, the rate between India and Great Britain was four shillings a word. It has been reduced to half a crown. but even that figure is much too high.

The Three Hundredth Anniversary of Otto von Guericke's Birth.

The 20th day of November, 1902, marked the three hundredth anniversary of the birth of Otto von Guericke, perhaps the most distinguished of the seventeenth century German experimental philosophers.

Guericke was the son of a Magdeburg councilor. When he was but fifteen years of age he matriculated at the University of Leipzig as a student of law. But the wars of the time put a summary end to his studies. Following his natural bent, he journeyed to Leyden and there studied physics and mathematics. During his student days (1620) Guericke's father died. Six years later, when he had hardly attained the age of twenty-four, Otto von Guericke was elected to a seat in the Council of the city of Magdeburg—such were his attainments even as a youth. Versed in engineering matters as he was, it was but natural that he was entrusted with the strengthening of the fortifications. The task thus allotted to him gave him much to do, especially at the time of the city's investment by Tilly. The terrible catastrophe which followed the storming of Magdeburg, May 10, 1631, almost cost the famous philosopher his life. Absolutely penniless, he managed to save himself with his young wife and his children. He was led into Tilly's camp and held a captive until the ransom which had been set upon his head had been paid. His reputation as a great scientist soon became known in the camp. After he had repaired a watch belonging to one of the imperial officers, his lot and that of his family became somewhat easier. The officer for whom he had acted as a watchmaker gave Guericke a ducat for his work. Long after, when he had attained a ripe age, Guericke used to recall this incident with pleasure. Finally, in January, 1632, the imperial army evacuated the city, and the inhabitants, among them Otto von Guericke, returned to their homes. At that time Guericke was perhaps the most respected and widely known personage of the town. He was overwhelmed with requests for assistance from the inhabitants, who had been compelled to impoverish themselves by quartering the imperial soldiers. In Guericke the inhabitants found an indefatigable friend. He saw to it that the new structures and fortifications that had been planned were carried out. We find him undertaking long and arduous journeys to Leipzig and Osnabrück, Münster and Regensburg, Prague and Vienna, for the purpose of interesting the great lords of those places in the welfare of the town of Magdeburg, to beg their protection and the withdrawal of the troops that had been quartered in the town for years. In order to win the protection of the Swedish General Torstenson, he made a most wonderful gilded celestial globe, which was turned by concealed clockwork. And this work of exquisite craftsmanship he presented to Torstenson, but without influencing the Swede the least in the city's favor. In recognition of his great services Magdeburg elected Guericke its Burgomaster in 1646. The city's condition having been considerably ameliorated and the inhabitants started on the road to prosperity, he could take up again the experiments which he had been compelled to abandon.

About this time Torricelli had proved that air was by no means incorporeal and imponderable, but that it exerted a pressure upon all bodies. It was a matter of great scientific importance to produce a vacuum, in order to prove its effect upon bodies therein contained. Guericke began by experimenting with a pump on water placed in a barrel, but found that when the water was drawn off, the air permeated the wood. He then took a globe of copper fitted with a pump and stopcock, and discovered that he could pump out air as well as water. Thus it was that Guericke became the inventor of the air pump (1650). This important discovery was publicly explained before the Emperor Ferdinand III. at the Imperial Diet which assembled at Ratisbon in 1651. At the same time Guericke illustrated in a simple but effective way the force of atmospheric pressure. Placing side by side two hollow hemispheres of copper, he exhausted the air from between them by means of a pump and stopcock, and it is recorded that thirty horses, some say twenty-four, were unable to pull the hemispheres asunder. Before the Elector of Mayence, Johann Philip, Guericke later repeated the experiments, employing hemispheres having a diameter of four feet. On this occasion twenty-four horses, twelve back to back, were unable to tear the globe apart. This experiment earned for Guericke an international reputation. Guericke further demonstrated with the aid of the air pump that in a vacuum all bodies fall equally fast, and that animals cannot exist therein. He also invented the air balance and the anemoscope, a species of weathercock, by means of which instrument he is said to have foretold the terrible storm of 1660. After the death of its inventor this precious apparatus was sold for 800 thalers.

Guericke was one of the first of the great experimental electricians. With his famous sulphur globes he discovered the property of electro-repulsion. He also made successful researches in astronomy, predicting the periodicity of the return of comets.

In 1681 he gave up his office of Burgomaster of the city of Magdeburg. Five years later, May 11, 1686, he died at Hamburg, at the house of his son. He was buried in the city to whose municipal prosperity he had contributed so much. In commemoration of these services, and in commemoration of his scientific achievements, the city of Magdeburg officially celebrated his three hundredth birthday.

Oil Fuel on the Pacific.

The American-Hawaiian Line, which operates a fleet of steamers between New York and San Francisco and Honolulu, is one of the first freight lines to adopt oil as a fuel. The fleet consists of the "American," "Hawaiian," "Oregonian" and "Californian," of 8,000 tons each; "Alaskan," "Texan" and "Arizonian," 11,000 tons each; and the "Nevadan" and "Nebraskan," 6,500 tons each. These last two steamers are designed exclusively for the San Francisco-Honolulu trade. The entire fleet is completed with the exception of the "Arizonian," which will be finished in about two months. The "Nevadan" and "Nebraskan" have already been fitted with tanks for carrying oil. The other steamers will be equipped with the apparatus as fast as possible.

The "Nevadan" was recently described in the columns of the SCIENTIFIC AMERICAN. She has made three round trips between San Francisco and Honolulu, using oil as fuel. The distance covered was 12,500 miles. In the last trip of the "Nevadan" to Honolulu, which was begun at San Francisco on October 9 and terminated on October 16, the Superintending Engineer of the line gave out the following statement:

"The results were better than were expected. The boilers and engines were worked to their full capacity. Not a burner was stopped throughout the trip. The steam was kept at 200 pounds with no variation of more than a pound or two. Ordinarily there was not the least sign of smoke from the stack. The boilers developed 2,500 horse power. Only 1.22 pounds of oil were used per indicated horse power. The consumption was 3,006 pounds, or nine and one-fourth barrels of oil, an hour. The time of the trip was seven days and three hours, and the average hourly speed was 12.3 knots. Running with coal, we would have made one knot less speed. The advantage of oil over coal, as indicated by our experience, is that 20 per cent more power can be obtained from the same boilers. Not only this, but the pressure is manipulated at the same point. There is a reduction in the cost for labor in the fireroom. We save twelve men. Instead of nine firemen we use three, and are obliged to have no coal passers, of whom we should require six if using coal.

"On the return trip the engineer was directed to run at a speed of ten knots an hour as an experiment. The steamer left Honolulu on October 27 and arrived in San Francisco on November 4. The speed was 10.54 knots an hour. The burners worked with the same success as on the outward trip. The amount of oil burned was 1,390 barrels, or 7.2 per hour. This was 191 barrels less than on the outward trip. The horse power developed was 1,834. The amount of oil burned per indicated horse power was 1.27 pounds. While the difference in the quantity of oil used was 191 barrels,

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it cost a day's time. Apparently it is more economical to use the maximum power of the boilers and engines. We have found that a pound of oil will evaporate from 14 to 15 pounds of water, while a pound of coal will evaporate only from 9 to 9¼ pounds."

Two-Cycle Automobile Engines.

BY E. W. ROBERTS.

Nothing except an unwarranted prejudice has prevented the two-cycle gasoline engine from as wide use for automobiles as for the motor boat. This prejudice may perhaps be accounted for by the fact that the earlier development of the gasoline automobile was in the hands of the French, with whom the two-cycle engine is practically unknown. Originally an English invention, the two-cycle engine having precompression in the crankcase has attained its fullest development in the hands of American manufacturers. To-day, probably ninety per cent of the small American-built motor boats employ two-cycle engines. The great demand for marine engines has been the most potent factor in preventing the makers of two-cycle engines from applying them to the automobile on a commercial scale. Where they have made such application, they have invariably found the two-cycle engine to give excellent service in the automobile. Such unsuccessful applications of this kind as have been made may invariably be traced to inexperience in two-cycle engine design. In the case of the marine-engine builders, the great demand for launch engines has prevented their further development of the automobile motor.

Fortunately, however, the adaptation of the two-cycle engine to vehicles was taken up by a firm building automobiles only, and hence its development on automobile lines has in this case proceeded without being handicapped by the demands of another branch of the business. Fighting the battle practically alone, the firm in question has so far overcome the popular prejudice that I do not believe there is an owner of one of their two-cycle automobiles who would care to change for one of the more complicated type.

Mechanically, the two-cycle engine bears the same relation to the four-cycle type that the oscillating steam engine bears to the slide-valve engine. If anything, the diversion is more marked in the case of the gas engine. In the two-cycle automobile engine there is not a valve or a moving part of any kind on the outside, all the functions of the valves being accomplished by the piston uncovering ports in the side of the cylinder at the proper time in the stroke. Even the igniter is operated directly from the piston without a cam, an eccentric, or a lever, outside of the cylinder. In fact, so simple is the engine, that once adjusted at the factory it will run for months without alteration. Such adjustments as are required at any time are no more than the tightening of the connecting-rod bearing or the igniter spring. As to flexibility, these engines have proven themselves fully equal to the four-cycle engine, and under throttle control without change of igniter lead they will run at speeds varying from 175 r. p. m. to nearly 2,000 r. p. m.

Given a two-cycle engine that will operate equally well in comparison with a four-cycle engine, its advantages are twofold. Having an impulse in each cylinder for each revolution of the crankshaft instead of every alternating revolution, as in the four-cycle engine, it will run much more steadily; so that for steady running a two-cylinder two-cycle engine is in every way equal to a four-cylinder four-cycle. Again, since it receives more frequent impulses, its power, weight for weight, is considerably greater than that of a four-cycle engine. The greater frequency of impulses also permits of the use of lighter flywheels on a two-cycle engine than on a four-cycle of the same size.

The unwarranted assumptions of some writers that the two-cycle engine will not keep up its turning moment with increase of speed is entirely disproven by tests that the writer has made. For instance, a 4-inch x 4-inch two-cylinder, two-cycle engine gave 4 horse power at 400 r. p. m. and 10 horse power at 1,000 r. p. m. In fact, the pull on the brake lever at the lower speed was but two or three ounces more than at the higher speed.

In a quite recent work on automobiles its author states that "while a four-cycle engine of a given horse power will run at as high a speed as 1,200 or 1,500 r. p. m., a two-cycle engine of the same power can make no more than 300 or 350 r. p. m." This statement is so far from the facts that it is truly nonsensical. In reality, there is absolutely no reason why a properly designed two-cycle engine should not run at as high a speed as a four-cycle. A carriage under the writer's observation has made mile after mile in a track test. on the second speed, with the engine above referred to running at 1,650 r. p. m., and doing it without a break, skip, or miss of any kind. In view of what experiments have been made, I am fully confident that this same engine can be operated without the slightest difficulty at 2,000 r.p.m. or more. In practice, where the same care is taken with the design of a two-cycle engine as with a four-cycle engine for the same service and the same speed, each will run with equal facility, and owing to the greater simplicity of the two-cycle engine, much less trouble will be experienced with disordered parts. The reader is particularly requested to note that the statements made in this article are not mere assumptions, but an account of what has been done.

In regard to service on the road, the two-cycle automobile has shown up equally well, if not better than the more complicated type, having come through both the 100-mile non-stop contests on Long Island with a clean record; while in the New York-Boston Endurance Run, two vehicles received first-class certificates, and one of them went through without any penalized stops. A two-cycle machine made a run from Detroit to Niagara Falls through Canada, returning on the American side, the whole trip covering over 1,000 miles of road, through sand, mud, clay, and some of the worst roads possible to imagine. At no time was there any trouble with the engine with the exception of the igniter wires getting loose; and, quoting from a letter written by the operator, he says: "During this trip I will say that we found no hills too steep, no mud nor sand too deep for our machine to climb or go through." It should also be added that this machine, although built for two passengers, carried three people and considerable luggage. It is notable that the owner's bill for repairs on this entire trip was only twenty cents. However, it must be said that he was extremely fortunate, as he had no more serious accident than a collision with a hidden stone, which broke two spring-bolts, the replacing of which was his only repair.

An Ocean Race of Warships.

The ships of the North Atlantic Squadron have recently engaged in a long-distance speed contest in the open sea. The naval regulations provide that new ships shall be speeded at their utmost at intervals. An opportunity presented itself a week ago, when the ships of the squadron were being assembled for the winter naval maneuvers. Under orders of the Navy Department, five of the ships lined up for a run from Hampton Roads on Saturday, November 15—the "Alabama," "Kearsarge," "Massachusetts," "Indiana," and the "Machias." This squadron included some of the oldest and newest battleships in the American navy. Thirty-five miles behind the vessels as they passed the Virginia capes followed the protected cruiser "Cincinnati." Speedier and lighter as she is, the 35 miles were for her a fair handicap. Almost from the time the starting gun was fired and the ships headed for Culebra, the "Alabama" forged ahead. So far as the battleships were concerned, it was a race between the "Alabama" and "Kearsarge," the products of two rival shipyards. The "Alabama's" superiority was soon demonstrated. In the first two hours she ran away from her rival, and four hours from the start, just before twilight, she left the "Kearsarge" hull down astern. The "Massachusetts" kept up surprisingly well, and proved a far stronger competitor to the "Alabama" than the newer "Kearsarge." But before night the older ship was also left behind.

At sunset on Monday, when all the battleships had long been distanced, the "Cincinnati" was sighted. She had made up her handicap and was fast catching up to the "Alabama." The two ships were pushed their utmost all day Monday and on Tuesday and Wednesday. When the Culebra Light was reached, the "Alabama" was under forced draft two miles astern of the cruiser. The "Kearsarge," "Massachusetts," "Indiana" and "Machias" were not in sight.

During the run the "Alabama" had steamed eight hours at full speed under natural draft, and had averaged 15.2 knots. Her average speed under forced draft for four hours was 16.65 knots. On her official trial trip the "Alabama" made 17.103 knots under forced draft. The "Kearsarge" during her builders' trial in September, 1899, was credited with 17.25 knots under forced draft; but her official average for four hours on her government trial was 16.816 knots. The "Cincinnati," which was built in the New York Navy Yard by the government and launched in 1894, made a record of 17.5 knots on her speed trial. In 1896 the "Massachusetts" made a run of 16.21 knots an hour. A year ago both the "Massachusetts" and "Alabama" were tried over the Barren Island course at Chesapeake Bay, with assisted draft instead of forced draft. Both ships recorded 15 and 16 knots an hour.

The use of oil lamps on yachts has always been a drawback and this has just been overcome on the pleasure schooner Thistle of Robert E. Tod by the introduction of acetylene. This gas is not generated on board, but on shore, and is brought on the vessel in tanks under pressure. These are stored in the bow of the craft, the tanks being removed as the pressure becomes low and replaced with freshly charged ones.

Science Notes.

B. Brauner has examined all the possible positions of the metals of rare earths in Mendelejeff's periodic system. He arrived at the conclusion that this group of elements may present some analogy with the group of asteroids in the solar system, forming, in the periodic system, a sort of link between cerium and the unknown element of the atomic weight 180. This interperiodical group is thus the continuation of the eighth line, terminating with the tungsten-platinum elements; gold is shown to be the first term of the ninth, and not of the eleventh line. The first element of the twelfth line is probably radium, followed by thorium and uranium.

A unique specimen of an Egyptian tool has been received by M. Albert Colson, of Paris, who gives an account of its fabrication and the character of the metal. The tool is a cold-chisel of the time of the Sheban dynasties, formed of a hard bronze blade whose present thickness is 0.12-inch and width 0.72-inch. The cutting bevel is made at an angle of 60 to 65 degrees. This hard alloy is inserted in an outer covering or sheath of soft and malleable bronze 0.6-inch thick, which covers it quite up to the cutting edge. This outer sheath has been either used as a mould for the central part or been added outwardly by hammering at a high temperature. In any case it is effective in giving the hard and brittle metal of the tool the elasticity necessary for receiving the shocks of the hammer. This artifice is analogous to that used at present in automobile construction for obtaining parts which are resistant alike to wear and to shocks; the pieces are made in soft steel and the parts exposed to friction are hardened by cementation. The non-cemented part preserves the elasticity of the piece, which if entirely hardened would be too brittle. In this case the soft steel is in the interior, while in the Egyptian tool the soft bronze is on the outside. The sheathing, unlike the central core, is of a laminated texture. The surface which separates the two alloys is marked by a black oxide, often stained with verdigris. The two alloys were separated and after cleaning were found to have different densities. The envelope, although more oxidized, gives d=5.33 and the core d=5.18. This anomaly showed that the former is richer in copper than the latter, as was proved by analysis. If a part of the tool is reduced by hydrogen near 500 deg. C. the envelope takes a red copper-color and the interior a buff-yellow. The following shows the composition of the bronzes which compose the two parts. After cleaning the alloys were first reduced by the blowpipe and found to lose in each case about 15 per cent of oxygen and 3 or 4 per cent of carbonic acid, sulphur, chlorine, etc. Then followed the analysis of the reduced metal:

	Envelope.	Central portion.
Oxygen	1.65	1.60
Chlorine and sulphur	0.80	traces
Iron	0.70	0.30
Lime and potassa	"	0.15
Tin	4.67	13.30
Copper	92.60	84.60

The hard bronze thus contains less copper and considerably more tin than the soft. The presence of chlorine and sulphur is due to the earth in which the tool had been buried. The lime and potash seem to come from the ashes of the fire which melted the alloy, for after reducing the powdered metal by hydrogen and treating with boiling water the solution sometimes turns red litmus to blue. The lime is thus in the free state and the potash in the form of carbonate.

The Current Supplement.

The current SUPPLEMENT, No. 1404, opens with the first installment of a most complete account of the Langley aerodrome—perhaps the only machine of its kind built on truly scientific principles, and actually tried. The article is very fully illustrated. Henry G. Kittredge continues his exhaustive discussion of the utilization of wastes and by-products in manufactures. Some notes on experimental researches on internal flow in centrifugal pumps and allied machines have been prepared by James Alex. Smith. The subject is one of considerable physical interest. "The Contact Process for the Manufacture of Sulphuric Acid" is the subject of an article which will doubtless be found of no little value to chemists. A new French process for sterilizing water is described and illustrated. Among the minor articles may be mentioned those on "Ferro-Concrete," "Oil Burning with Forced Draft," "The Phenix Accumulator," "Distribution of Light from the Nernst Lamp" and "Compensation for the Weakening of Permanent Magnets." Automobilists will read with profit an article on how to remove the inner tube of a double-tube automobile tire. The usual notes have also been published.

Ziegler's New Leader.

Ziegler has decided his next expedition to the North Pole will be headed by Anthony Fiala. The "America" is soon to be refitted, and the second expedition sent off as soon as possible.

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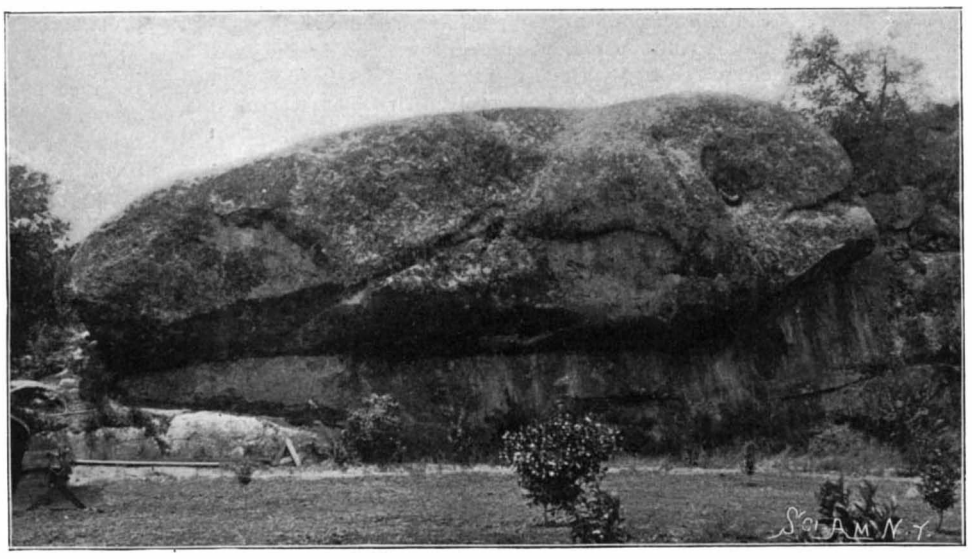
NATURAL EFFIGIES.

At Conchise, Ariz., the passenger on the Southern Pacific Railroad is shown a wonderful face, formed by the summit of a mountain range. It is called the face of Sleeping Conchise, a famous Indian chief, and is said to be held in more or less reverence by the Indians who have seen it. The profile is remarkable, doubtless several miles in length, and from certain localities a perfect face gazing upward with wonderful dignity.

In almost every portion of the country strange faces or forms are found, but none are more remarkable than the stone whale here shown. Nearly twenty years ago the writer heard of this natural curiosity, his informant urging him to go and see the whale high in the mountains. Vertebræ of these huge creatures were not uncommon on the summit of the Coast Range Mountains, and the writer had seen the skeleton of a whale dug into when a street was being opened in the city of Los Angeles; indeed, remains of these animals were found in various portions of the State, hence the story of the whale in the mountains did not result in a long trip at that time, and the natural effigy was not seen until many years after, when making a coaching trip from Los Angeles to Santa Barbara. One afternoon, after crossing a little stream in Ventura the coach rolled out into a country road and came to a standstill by the side of the whale, an effigy so remarkable that it was easily seen how the early natives were attracted by it and had legends referring to it. The whale is a conspicuous landmark, and stands on the Los Angeles, Ventura and Santa Barbara highway, pointing to the east and attracting the notice of all who pass that way.

CHARLES F. HOLDER.



A STONE WHALE IN A MOUNTAINOUS REGION OF CALIFORNIA.

THE D. O. MILLS EXPEDITION TO THE SOUTHERN HEMISPHERE.

BY W. W. CAMPBELL, DIRECTOR OF LICK OBSERVATORY.

It is well known that the observed positions and motions of celestial objects are influenced not only by the motions of the bodies themselves, but also by the motions of the observer. Neglecting minor disturbances such as latitude variations, precession, nutation, etc., the observer's motion is made up of four principal components:

1. That due to the rotation of the earth on its axis. The elements of this diurnal component are well known, and it can be eliminated completely from an observation. 2. That arising from the revolution of the earth around the common center of mass of the earth and moon. This monthly component is small and readily allowed for. 3. That due to the annual revolution of the earth around the sun. The form of the earth's orbit is well known, but there is at present an uncertainty of from one-quarter to one-half of one per cent in the assumed value of the solar parallax, or in the absolute value of the semi-major axis of the earth's ellipse. This introduces a slight uncertainty in the observer's speed which is troublesome in a few cases. It is hoped that as a result of recent observations of the planet Eros, we shall be able to eliminate the greater part of this uncertainty. 4. That due to the motion of the solar system as a whole. The elements of this motion are not well known. In fact, a better knowledge of them constitutes one of the most pressing problems in astronomy, and it is to contribute to the solution of this problem that the Mills expedition to Chile has been organized.

More than one hundred years ago, Sir William Herschel, from a consideration of the proper motions of the few stars previously observed, came to the conclusion that the solar system is moving in a straight line approximately toward the constellation Hercules. This was one of the shrewd guesses for which Herschel is justly famous. Later solutions have been made by other astronomers every few years, using the steadily increasing number of observed stars. Their results confirm the approximate correctness of Herschel's guess as to the point toward which the solar system is moving, as this point has been located by all of them either in Hercules or in Lyra. Nevertheless, the various solutions arrived at leave an uncertainty of at least ten or fifteen degrees as to the direction of the motion.

Our knowledge of the speed of the solar system has been much less satisfactory. Herschel had essentially no information as to the distances of the stars, but by making certain assumptions he was led to the conclusion that the speed of the solar system was probably in the neighborhood of ten miles per second. Other discussions of the question have led to the assignment of values ranging from as low as five miles to as high as twenty-five miles per second. The weakness of the solutions arises from our very imperfect knowledge of the stellar distances.

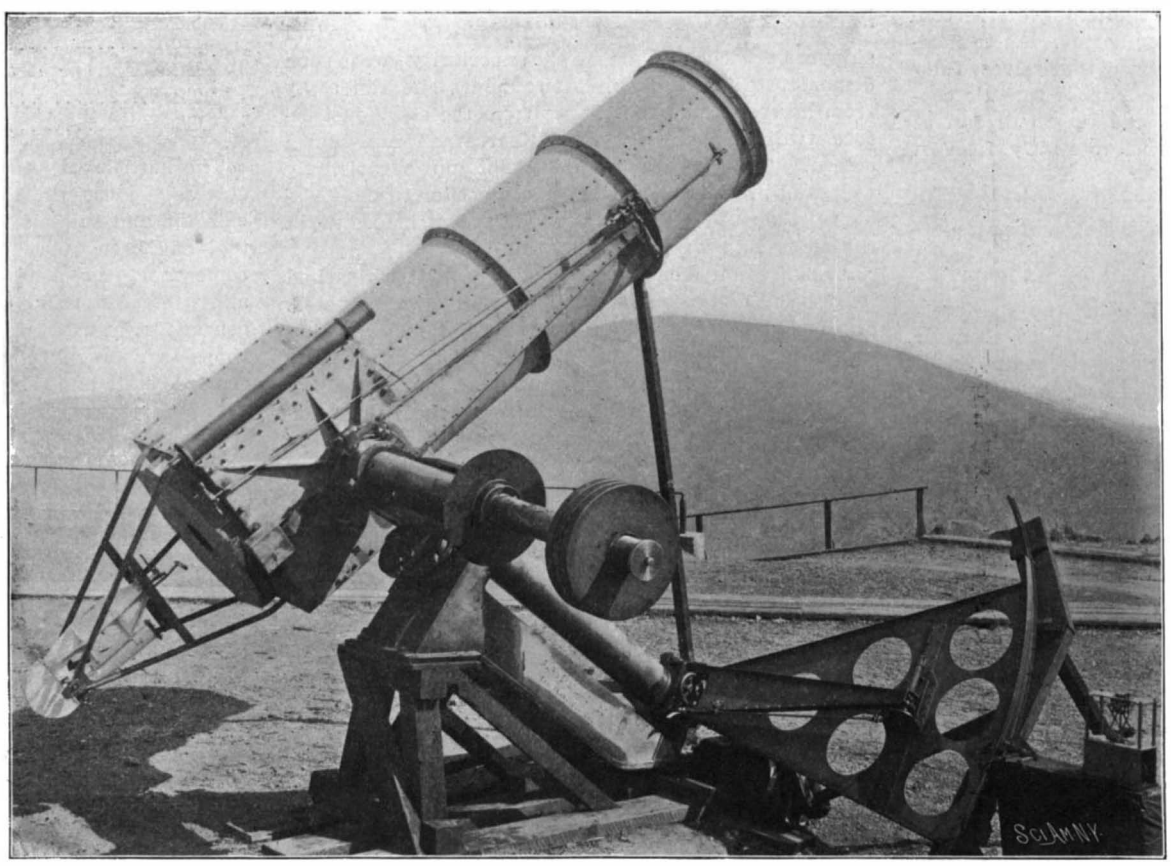
The development of the spectroscopic method of measuring stellar velocities in the line of sight has placed in our hands a means of making decided improvements in our knowledge of the solar motion, as this method is entirely independent of stellar distances. The method is exceedingly simple in theory, but extraordinarily difficult in practice. The displacements of the stellar spectra due to their velocities of approach and recession are on so slight a scale that the errors of observation may easily exceed the magnitude of the quantities to be observed. Fortunately the thorough understanding of the problem, reached through bitter experience in the past fifteen years, has made it possible at the present time to measure stellar velocities with a high degree of accuracy.

The velocities of some four hundred of the brighter stars have in the past six years been measured with the Mills spectrograph attached to the great Lick telescope. These stars are situated between the North Pole and 30 deg. south declination, and are distributed more or less uniformly over this section of the sky. The results have been combined in an attempt to determine the elements of the stellar motion. It is evident that while the individual stars have their individual motions, yet if the solar system is moving toward a given point in the sky, the stars in that portion of the sky will on the average appear to be moving toward the solar system; and that the stars in the opposite portion of the sky will appear to be moving away from the solar system. Conversely, if the velocities of the stars in all parts of the sky be known, it is possible by mathematical analysis to determine a point such that the stars within a concentric area will have the maximum velocity of approach toward the solar system, and the stars in the corresponding opposite area will have the maximum velocity of recession. The solution referred to led to the result that the solar system was moving approximately in the direction of the southern boundary of the Lyre with a speed of 12½ miles per second.

There is no doubt that the result for speed is close to the truth; but it is reasonably certain that the direction of motion is somewhat in error. The weakness of the solution lies in the fact that the observed stars are not distributed uniformly over the *entire* sky. The region from 30 deg. south declination to the South Pole is not represented at all. This deficiency in the observed data affects the direction of motion vastly more than it does the speed.

It has for many years been my desire to organize a spectroscopic expedition to the southern hemisphere, for the purpose of extending the observations to the South Pole of the sky. The problem under solution, and the needs of such an expedition, were recently brought to the attention of Mr. D. O. Mills, who most generously provided funds for constructing the apparatus, for employing the astronomers, and for meeting all general expenses.

The telescope recently constructed for this purpose is shown in the accompanying illustration, set up on Mount Hamilton for adjustment and trial. It is a reflector of the Cassegrain form. A parabolic mirror of silver-on-glass will be mounted in the extreme lower end of the tube. This mirror, now rapidly approaching completion, is 37¼ inches in diameter and 5⅞ inches thick. The accurately polished surface is 36¼ inches in diameter. There is a hole 5 inches in diameter in its center. The rays of light from the star would be brought to a focus 17½ feet above the mirror; but a hyperbolic convex mirror 9¾ inches in diameter is to be placed 4½ feet inside the focus, just within the upper end of the tube, to receive the converging beam of rays from the large mirror and reflect them back through the hole in its center. The rays will thus be brought to a focus about 12 inches below the lower end of the telescope tube, exactly on the slit of a powerful spectrograph. The spectrograph is shown supported by a steel truss. In theory it resembles the Mills spectrograph now in use at the Lick Observatory; but in reality it embodies many new departures in design. Hitherto the conventional spectrograph has been supported entirely from its upper extremity, the entire instrument projecting out into space "at arm's length," so to speak, thereby inviting injurious flexure effects. The present instrument is supported at two points in such a way that strains in the supporting truss cannot by any possibility induce strains in the spectrograph.



THIRTY-SEVEN-INCH MILLS REFLECTING TELESCOPE AND SPECTROGRAPH.

The telescope is mounted equatorially in the usual way. Motion is communicated to the instrument, however, in a somewhat unusual manner. The large sector on the right carries a groove in its edge accurately turned to the arc of a circle; and attached to the lower point of the arc is the clock cord. This follows in the groove to a point on a level with the clock, where the cord can be seen running to the winding drum. The

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weight of the steel sector is sufficient both to turn the telescope on its polar axis and to propel the clock. The governor of the clock releases the cord at the proper speed to cause the image of the observed star to remain in the slit of the spectrograph.

The mounting of the telescope was designed in general by the writer, and in detail by the Parke & Lacy Company, of San Francisco. It was constructed in the shops of the Fulton Engine Works at Los Angeles. The optical parts of the telescope and spectrograph are from the well-known shops of the John A. Brashear Company. The spectrograph and clock were constructed by our instrument-makers. The instruments are to be contained in a 30-foot steel dome constructed by the Warner & Swasey Company, of Cleveland, Ohio.

The dome and instruments will be mounted on the summit of one of the low hills near Santiago, where they will remain for two or three years. It is planned to measure the velocities of three or four hundred of the brighter stars in the one-quarter of the sky surrounding the South Pole. The photographs will be sent to the Lick Observatory for measurement and discussion. It is confidently expected that a combination of the spectrographic results obtained at Mount Hamilton and at Santiago will lead to a very satisfactory solution of the perplexing problem of the motion of the solar system through space.

There is little doubt that, as in the Mount Hamilton observations, the discoveries made as by-products of the investigations will rival in scientific interest the results which comprise the main purpose of the work.

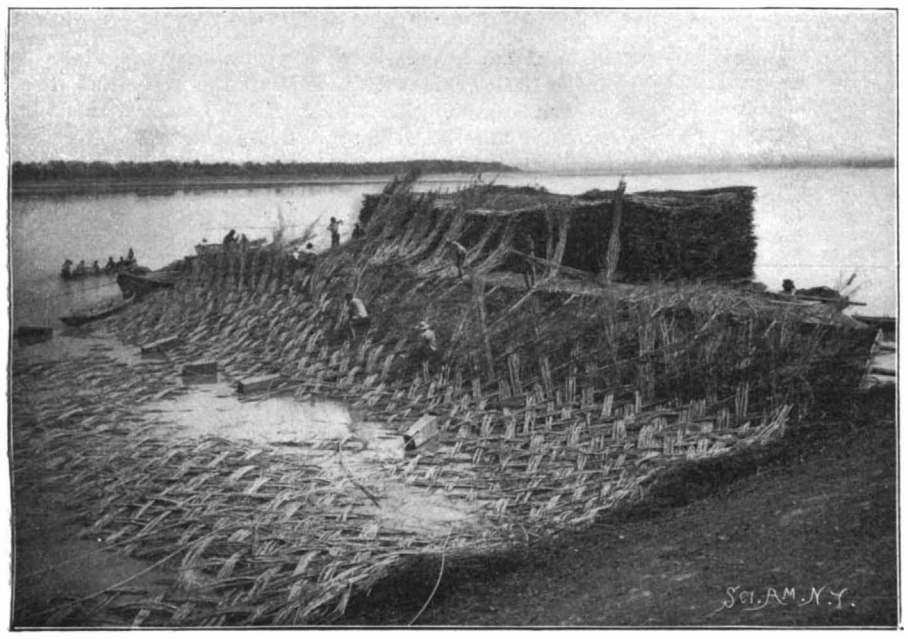
The expedition will be in charge of Acting Astronomer W. H. Wright, who has ably assisted in the observations made with the Mills spectrograph in the past five years. He will be accompanied by Assistant H. K. Palmer. The government of Chile has offered to further the purposes of the expedition in every possible manner.

PROTECTING A RAILROAD FROM FLOOD CURRENTS.

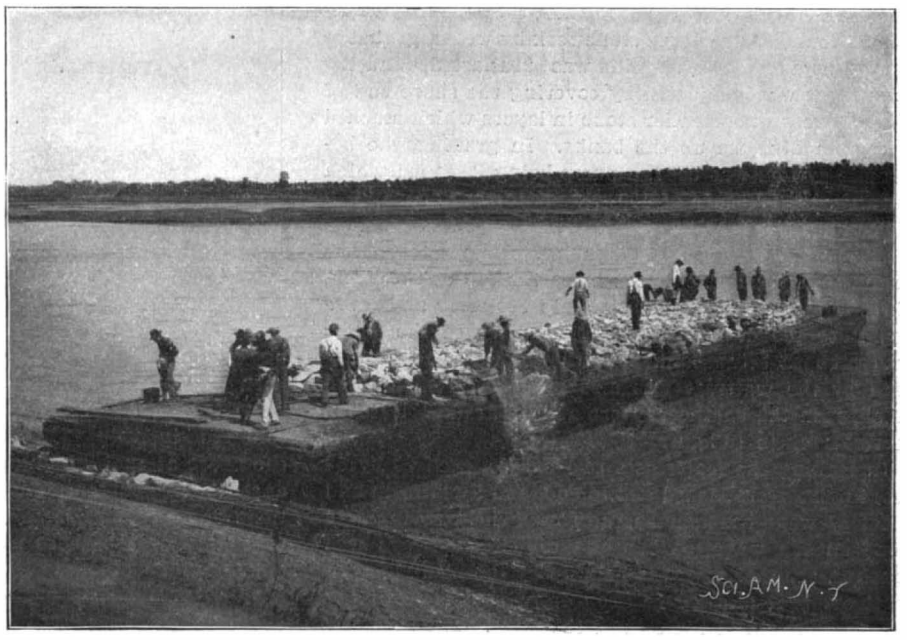
BY DAY ALLEN WILLEY.

A piece of revetment has recently been built along the Missouri River in the vicinity of the town of Cambridge which has attracted much attention from engineers on account of the plan of construction, its comparatively low cost and the permanent protection which is afforded to the banks. It is perhaps unnecessary to say that the shore on either side of the Missouri for many miles is of such a formation that even slight currents frequently cut away much of the earth, while during periods of high water the current is so strong as to do considerable damage, often materially changing the river bed at bends and other points where the contour of the shore offers obstruction to the water.

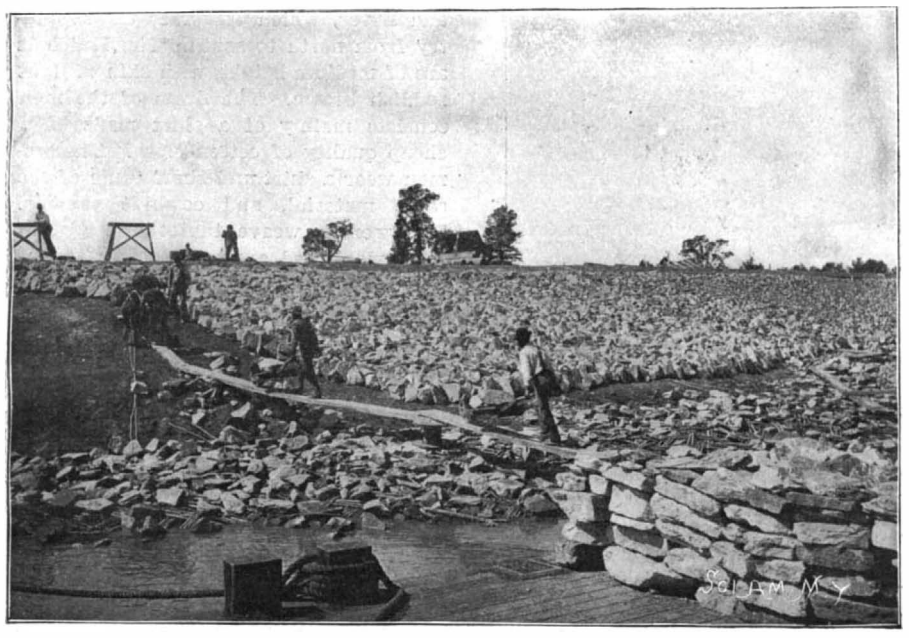
For several miles the tracks of the Chicago & Alton Railway follow the river, in the vicinity of Cambridge, crossing it near the town of Glasgow by a steel bridge which is one of the longest structures of this kind in the West. It was completed in 1900 and is 2,435 feet



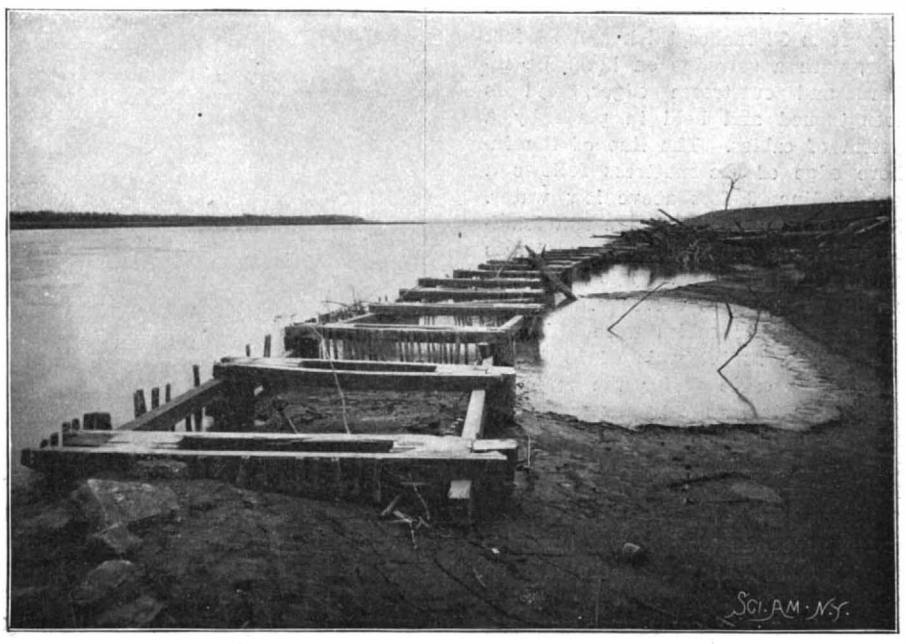
Weaving the Mat.



Sinking the Mat by Dumping Rock upon it.



Paving the Bank.



Government Dike to Prevent Scouring the Bank.

Hydraulic Grader at Work on the Bank.

Eastern End of the Mat Completed and Sunk.

PROTECTING A RAILROAD FROM FLOOD CURRENTS.

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in length including viaduct approaches, deck spans, and a channel span which in itself is 338 feet in length. The bridge and approaches cost in all about $500,000. Near one of its terminal points the shape of the bank recently suffered from floods to such an extent that the railroad company found some plan of protection was necessary. After a careful examination the chief engineer determined upon a plan which has been carried out in several portions of the country by the government engineers, and the work was begun with the approval of the Missouri River Commission. The plan consisted of first grading the banks, then making an artificial foundation for the stonework by weaving what is known as a "mattress." This was "ballasted," and the revetment was completed by covering the shore end of the mattress with smaller stone in layers which reached a certain distance up the banks. In grading, the hydraulic system was used, a pump being installed which furnished a pressure of 100 pounds to the square inch, throwing the water through a 4-inch pipe fitted with a nozzle of 1½ inches in diameter. This stream was found to be sufficient to cut away the top of the bank, throwing the surplus material into the river and leveling it to the desired grade. The force of the water was such that the bank beneath the water to be covered by the mattress was also graded. With a force of six men the engineers were able to grade 100 linear feet of bank in 10 hours.

In making the mattresses two barges, each 20 by 50 feet in size, were lashed end to end, and a platform and a set of ways constructed thereon. The weaving was done on the ways. When the top of the ways was reached, the mattress was held up by the men, and the mattress boat allowed to drop down stream until the work was again at the foot of the ways. The mattress is woven of brush, 1 to 2 inches in diameter at the butt, and 15 to 25 feet in length, the "stitch" being over and under. It is 12 inches thick and 86 feet wide, with a selvedge on both the inshore and outstream edges, and is strengthened and held in place by a system of cables. The line of the inshore edge of the mattress follows a contour line, 3 feet above low water. Galvanized wire cables were run longitudinally, one cable under the mattress and one on top, and a single cable was run in the inshore selvedge. Similar sets or pairs of cables were also run transversely, at intervals of 16 feet 8 inches, one cable under the mattress and one on top. The transverse cables were anchored to posts planted on the main bank, back from the top of the slope. These anchors are yellow pine timbers, 12 by 12 inches and 4 feet long. To prevent the finished mattress from sagging, it was straightened as fast as completed by pulling upon the cables with block and tackle.

In sinking the completed mattress, the mattress boat was floated down the stream with the current, the mattress itself being left to float on the surface. A barge loaded with bowlders weighing from 100 to 200 pounds each was then drifted upon the mattress, and the stones dropped upon it in such a way as to distribute their weight as equally as possible over all parts. The stone served as anchors to hold the submerged portion firmly in place on the bottom of the river.

One of the most difficult and interesting features of the revetment was the "paving," as it was termed, which extended from the top of the artificial grade to several feet beneath low water. The inshore edge of the mattress was covered with crushed stone from a point 3 feet below water to about 3 feet above, making a binding between it and the bank proper. Upon this was placed a layer of larger stone ranging from 8 inches to 12 inches in size, and extending as already stated to the top of the grade. It was wheeled in barrows to the graded banks and placed regularly in a sort of pavement. By following this plan much more resistance is offered to the action of the water than if the stone was merely thrown loosely upon the formation. A top dressing, however, was given the pavement, consisting of a layer of 2 inches of crushed stone, this filling the crevices and practically forming a solid embankment.

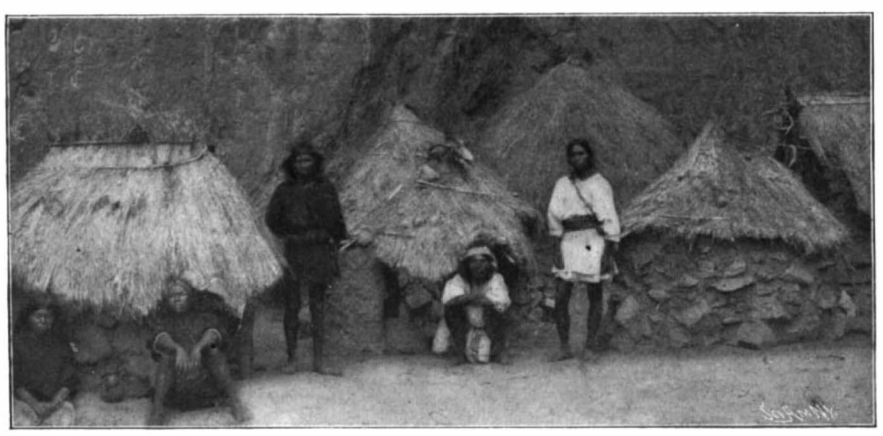
In spite of the apparently large amount of work required to carry out the various processes, the cost was less than $7.50 a linear foot of revetment, including all expenses. The force of men required to weave the mattresses comprised but 33 in all, who completed 90 linear feet in 10 hours, while 30 men were employed to unload the stone barges and 32 men for paving and supplying the paving material. With the force of labor divided in this way, the various portions of the improvement kept pace with each other, so that while a section of the bank was being graded, the mattress to cover it was being woven, etc.

The revetment which has been completed is 8,250 feet in length, and apparently will resist the action of the river even during the times of the highest water. It is considered superior to dikes and other formations for protection, for the reason that the submerged portions as well as the construction above the water are so bound together that the current can-

NOAH'S ARK OF THE HUICHOL INDIANS.

not work behind the bank where the improvement has been made—a frequent cause of injury to dikes, as indicated in the accompanying photograph. The plan followed in this instance leaves the formation of the shore at such an angle as to offer no direct resistance to the current, and it is believed will require little or no repairs for a period of years, although the formation of the shore at this point, as already intimated, is of loose material.

A change from steam to electric power on the Georgetown & Portsmouth Railroad has resulted in throwing upon the market a lot of second-hand rolling stock. It was first thought that this rather expensive equipment would be converted into junk, for the reason that the railroad is of narrow gage. A bargain has, however, been made with a large contracting company, interested in the construction and operation of roads in China, for the purchase of engines and cars, both passenger and freight. The rolling stock is to be shipped to China to be used on a road of similar gage now under construction.



GOD HOUSES OF THE HUICHOL INDIANS.

THE GRANDMOTHER GROWTH OF THE HUICHOL INDIANS.

THE SYMBOLISM OF THE HUICHOL INDIANS.

BY WALTER L. BEASLEY.

Carl Lumholtz, the well-known Norwegian explorer, who has made three expeditions, occupying five years of research, among the natives of northwest Mexico, in the interest of the American Museum of Natural History, has brought back much valuable information and many strange and interesting ethnological objects. These have recently been installed in the new west wing of the institution, and form a most striking and comprehensive exhibit, illustrating the peculiar symbolism and culture of practically an unknown race of people, who are at present living in the same state of barbarism as when Cortez first put his foot on Mexican soil. Mr. Lumholtz is the first white man to visit and study the tribe. He succeeded in making friends with the leading shamans and tribal officials, from whom he obtained a great number of traditions and legends associated with the various symbolic and archeological objects collected. Of extraordinary interest among the specimens secured is the representation of an ark, together with the Huichol version of the same. There has been no Bible or priest among them for centuries, and they have forcibly resisted the intrusion of missionaries in recent years. Their old beliefs, customs and ceremonies all remain in their ancient vigor. Just how and when the Bible story found its way among the Huichols and became embodied in their mythology is unknown. Before explaining the ark and its symbolic significance, a brief outline of the Huichols is herewith given. The tribe number at present about 4,000, and they live in a rugged country, difficult of access, in the northwestern part of the State of Jalisco, among the Sierra Madre range. The territory is estimated to be about 40 miles long by 25 wide. All of their settlements—save one on a high mesa—lie on the east border of the Chapalagana River, which traverses their country from north to south. The Huichols are of medium height, with skin of light reddish brown. The dress of the men consists mainly of a shirt made of a cheap quality of cotton cloth. The women wear a skirt and short tunic of the same material, and cowhide sandals. The women weave tunics and girdles from wool, and are quite clever at embroidery, with which they adorn their dresses. They live in circular houses made of loose stones and mud, and covered with thatched roofs. They dwell in small ranches; only the officers of the tribe stay in the pueblos. The Huichols offer to their innumerable gods many remarkable symbolical objects, being the embodiments of prayers. These votive images are found in the god houses and sacred caves. All ceremonial objects lose their potency after five years, after which time they are thrown out and renewed. The gods are implored naturally for material benefits only. The moving principle in their religion is a desire of producing rain, thereby enabling them to successfully raise corn, beans and squashes, their principal food. One of the most unique and remarkable of the symbolic objects obtained from the Huichols is an ark, which was kept in one of the god houses, and deposited occasionally upon the waters of a small lake as one of the extreme measures of getting rain. To the Huichol mind what has once been associated with an effect has the power of reproducing that effect, and therefore the Ark, once connected with water, is thought to have the power of causing the water to rise and descend again, or in other words to produce rain. The following is the myth of the Deluge and the Ark of the Huichols as related by a famous shaman to Mr. Lumholtz:

Once upon a time, long, long ago, before the white man (the Spaniards) came to the country, a Huichol was at work felling trees in the preparation of his field for planting, but each day he found that the trees he had cut down on the previous day had grown up again. He worried over this and grew tired of working, but still he came on the fifth day to try once more, bent upon finding out how it happened. Soon there arose from the ground in the middle of the clearing an old woman with a staff in her hand. The woman was Taka'tsi Nakawe. This name means our Grandmother Growth. She is the mother of the gods. All the earth belongs to her, and she lives in the under world. All vegetation is her product, and she is the special goddess of corn, squashes and beans. She pointed with her staff toward the south, north, east and west, and finally toward below, when all the trees which the young man had cut down immediately stood up. Then he understood how it was that his clearing was always covered with trees. She told him he was working in vain. "A great flood is coming," she said; "it is not more than five days

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off. Make a box from the fig-tree as long as yourself, and fit it with a good cover. Take with you five grains of corn of each color, five beans of each color, take also the fire, and five squash stems to feed it with, and take with you a black female dog." The Indian did as Grandmother Growth had told him. On the fifth day he had the box ready, and placed in it the things he was told. Then he entered, taking with him the dog, and the old woman put the cover on. Then she seated herself on the top of the box with a macaw perched on her shoulder. The box or ark rode on the water, one year toward the south, next toward the north, the third toward the west, the fourth toward the east, and the fifth year it rose upward, and all the world was filled with water. The next year the water began to subside, and the box lodged on a mountain, where it may still be seen. The man took off the cover, and saw that all the country was still full of water, but the macaws and the parrots made valleys with their beaks, and the water commenced to subside. Then the land began to dry up, and trees and grass sprang forth, aided by Grandmother Growth. The man lived in a cave with his dog near by. In the daytime, while he was in the field, the dog remained behind. Every afternoon on coming back he found corn cakes ready for him. He was curious to know who made them for him. After five days had passed he hid among the bushes near the cave to watch, when suddenly he saw the dog take off her skin and hang it up, then he noticed that she was a woman, who knelt down to grind corn on the metate. He stealthily advanced toward her from behind, and quickly seized the skin and threw it into the fire, and from that time on she remained a woman. They were married, and the man had a large family, and his sons and daughters married, and the world became peopled and they lived in caves. The ark here pictured is made of a log of wood from a figtree that has been hollowed out. The bark has been entirely removed and the surface smoothed. Both ends are closed by disk-shaped covers, made from the same kind of wood. A piece of carved wood glued into a groove on the top is intended to represent deer-horns, its purpose being to entangle the craft in the bushes when the water subsided, and thus stop it. The outside part, which was supposed to be above the water, was decorated with various designs which are symbolic of water and its effects. The cover nearest the horns is decorated in the center with two Mexican centavos and are fastened with beeswax as an offering. One of the objects inside of the Ark was a wooden image, representing the ancestor of the Huichols, who was saved from the deluge; another being a rudely carved figure of the dog, painted black, and also the five squash stems, with which the ancestor of the tribe kept his fire going; five grains of each of the seven colors of corn, and the pouch in which they were preserved; likewise five beans, of the five different colors, and five squash seeds. It might be interesting to state that the late Frank Cushing, after examining the Huichol material, was of the opinion that they were in the same state of culture that the Zuni Indians had reached in remote prehistoric times, while in the matter of their highly developed symbolic art, they even more nearly represented the Maya of two to three thousand years ago.

Transatlantic Wireless Telegraphy Achieved.

Mr. Marconi has confirmed the report that messages were received on board the "Carlo Alberto" in Sydney Harbor from the station at Poldhu, Cornwall. The terms of Marconi's agreement with the Italian government prevent him from giving out further information; for the Italian government has reserved to itself the right to make public the results of Marconi's experiments on board the warship. Mr. Marconi states that several improvements have been made both in the transmitting and receiving apparatus, and that he is now able to send at a rate of forty words a minute. A year ago the best speed attainable was sixteen or seventeen words per minute.

Bacon's Fifty-mile Balloon Trip.

On the afternoon of November 10, the Rev. J. M. Bacon, the well-known aeronaut, accompanied by naval and military officers, ascended in a balloon from Douglas, Isle of Man, with the object of crossing the Irish Sea to the coast of England. Mr. Bacon descended in Dumfriesshire, Scotland. The distance over the sea to the coast of Scotland, reached with a northeast wind, is about 25 miles; but in reaching Dumfriesshire, at the Solway Firth, he traveled between 40 and 50 miles.

Word is received from abroad that wireless telegraphic communication between Berlin and Venice is to be established. A station with a range of 800 kilometers will be built at Ober-Schoeneweide. Should this experimental station be successful, communication will be established with Calais, Stockholm and Lemberg. Since the station is to be built in Germany, it follows as a matter of course that the Slaby-Arco system will be used.

The Press on Col. Astor's Gift.

The letter from Col. J. J. Astor, which the SCIENTIFIC AMERICAN published, in which the Astor turbine patents are generously given to the public, has received no little attention both in the lay and the technical press. Most of the New York dailies commented upon Col. Astor's magnanimity in appreciative terms. The New York Sun discussed the gift editorially. Perhaps the most complimentary notice which has as yet appeared was published in the well-known Electrical Review. The notice, which is an editorial, reads as follows:

"Col. John Jacob Astor, in a letter to the SCIENTIFIC AMERICAN, dedicates all his patents on marine turbines to the public, in the hope that the development of this idea may bring the steam turbine to a high state of perfection.

"Col. Astor's turbine consists of a funnel-shaped outer shell or drum, having on its inner surface spirally arranged blades. Within this there is a solid axle carrying spiral blades set in the opposite direction. Both parts of the turbine revolve in opposite directions, and each drives a screw at the stern of the boat. By allowing the inner turbine and the outer case both to revolve, the speed necessary to insure efficiency is cut in half.

"The following advantages are claimed for this type of turbine: As both parts revolve, the weight for a given output is reduced; the steam efficiency is high and mechanical friction is much reduced. It is suggested that this type of turbine is suitable for central station work, as the armature and field of the alternator can be driven in opposite directions. This would improve the efficiency of the dynamo and decrease the weight.

"Col. Astor's activity in public affairs is too well known to need comment. In the Spanish-American war he not only gave freely of his means, but he risked his life as well in the service of his country.

"By surrendering his rights in this case, he not only gives further evidence of this liberal spirit, but by throwing the construction of steam turbines open to competition he thereby greatly stimulates developments in this important line of work. The gifts of the rich to the public are often belittled by the saying that they are merely giving back what they in the first place took away. It is worth noting that this ungenerous comment does not apply to the gift of this invention to the public."

Some Early Anticipations of Modern Inventions.

Of Rabelais' story concerning the "frozen words" which startled Pantagruel and his happy crew on the voyage to the oracle of the Holy Bottle the world has long been familiar. Students of the great humorist maintain that the narrative of the "frozen words" must be taken to imply that their author had something akin to a prophetic vision of the phonograph.

In another direction it now appears that Rabelais played the seer and still nearer approached to a recent invention of unique creation. This relates to the "moving platform," a leading attraction at the Paris Exhibition in 1900, by which a passenger stepped on to a traveling road, or path, and was carried to his destination without further effort. If some features of this may be traced, by anticipation, to the mind of the old sage who defined rivers as "roads that travel," the real precedent is discoverable in the fifth book of Rabelais' series of masterpieces.

Rabelais, in the exuberance of his imagination concerning the Isle of Odes, where the roads travel of themselves, depicts Pantagruel and his gay mariners voyaging to the oracle of the Dive Bouteille, on the island of Odes. The term "odes," in spite of its associations, has nothing to do with poetry. On this pleasant isle where the roads travel of themselves, and thus (according to Aristotle's definition), must be classed as animals of locomotion, the traveler had simply to inquire his way of the road which was going to his destination, to get upon it, and so be carried, without further trouble, to the place he desired, just as happens to those who take passage from Lyons down the Rhone to Avignon and Arles.

Who forgets that Mark Twain, some years back, amusingly propounded a similar fancy when he took passage (by slow freight) on a Swiss glacier?

At the present hour the traveling road or path is under experiment in the suburbs of Paris, and is possibly destined some day to supersede omnibuses and tramways.

In the light of these facts it seems hard that Friar Roger Bacon, the student of science before the scientific period, who predicted that one day carriages would move without horses, and ships cross the ocean without sails, should be laughed to scorn as an addle-brained monk, whom much learning had made mad.—James Johnston, in Cassier's Magazine.

Brief Notes Concerning Patents.

It is said that over one hundred patents have been taken out by D. MacFarlan Moore, of New York, covering his system of electric lighting. The method, which has already been described in these columns, consists briefly of a series of tubes filled with a vapor which is made luminous by the passage of the electric current through it.

At the Western Standard Company, of Gas City, Ind., a test was made of a secret process of manufacturing paper from oat hulls. The inventor is said to have been working on the process for three years, the present being the third test which he has made. Although the two former tests were not very satisfactory, the last is reported to have been most successful.

The Board of Ordnance and Fortifications will probably ask for an increase in the annual appropriation from $100,000 to $200,000 for making experiments and trials of various kinds of ordnance and ordnance materials. This body is in constant receipt of inventions and suggestions which must be given some investigation.

In order fully to acquaint himself with the working of his new storage battery, Mr. Edison is building five automobiles which are to run five thousand miles each. It is expected to cover 100 miles with a single charging. A 62-mile run has already been made with a light runabout with 21 cells weighing 332 pounds; and after this trip, part of which was over steep grades, the carriage was still moving at 83 per cent of its normal speed.

C. J. Vernon, of Fresno, Cal., is the inventor of a peach-peeling machine which, it is said in a California paper, will prove invaluable to the canning industry. The machine has been subjected to a practical test at the San José plant of the California Fruit Canners, and it has been pronounced a success. The capacity of the plant has been largely increased by the introduction of this machine. The work is done without waste and without marring the round surfaces of the fruit.

Since the general adoption of the upright piano, about twenty-five years ago, there has been no very material improvement made, but a novel feature has been recently introduced by F. J. Heppe, the junior member of the firm of C. J. Heppe & Son, of Philadelphia, who has added two sounding boards to the one which is already in general use. Patents on this idea are now pending. The superior advantage of this invention is in the fact that two of the sounding boards are placed forward of the other, the top and bottom panels being converted into sounding boards, thus attracting the tone to the front of the instrument where it properly belongs.

A dispatch from Rochester, N. Y., announces the death of Mrs. Bridget French, who died at her home in that city on August 7. This woman was the inventor of no less than thirty-six devices, some of which had brought her considerable money. Her first invention was the French burglar-proof lock, which was the first thing of the kind and which laid the foundation of the modern complicated safety locks now in general use in banking and safety institutions. She also invented a steam sterilizer which attained wide use. She also devised a stovepipe damper with vents in it to permit the passage of the objectionable gases. She also invented a car coupler, and her latest work was a fiber lamp chimney. Although over seventy years of age, she was at work on several inventions at the time of her death. Besides the genius for mechanical devices, she possessed the skill of a trained artisan in developing the ideas originated by her. She worked regularly in her own shop, and could handle tools like any man.

An entirely new thing in boat building is in the course of construction at one of the yards near St. Louis, Mo. It is a boat which is designed to meet all the requirements of traffic in both deep and shoal water. The craft is the design of Capt. George O. Rogers, who is well known in transportation circles in the South, having been identified with marine and railroad companies. His boat consists of two hulls, one within the other, each forming a perfect boat. The inner hull is of much greater draught than the outer one, and in shallow water service the inner one is raised by means of jacks, so that the greater part of its weight is sustained by the outer hull and the upper works are raised about ten feet above the deck of the outer hull. In this position the boat has a very light draught, calculated to be available for use on the shallow rivers of the South. For deep-water traffic the inner hull is lowered. This boat was especially designed for the trade between the Beaumont oil fields and St. Louis, but the inventor sees a much wider range of usefulness for it. He expects to demonstrate its value by the boat which is now being built and which will soon be ready for service. Capt. Rogers was at one time a member of the United States River Commission.

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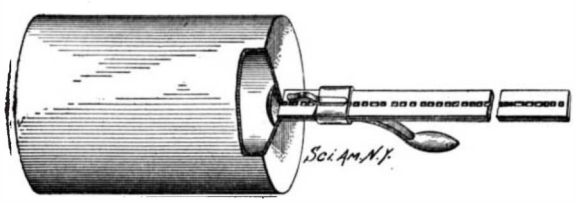
ODDITIES IN INVENTIONS.

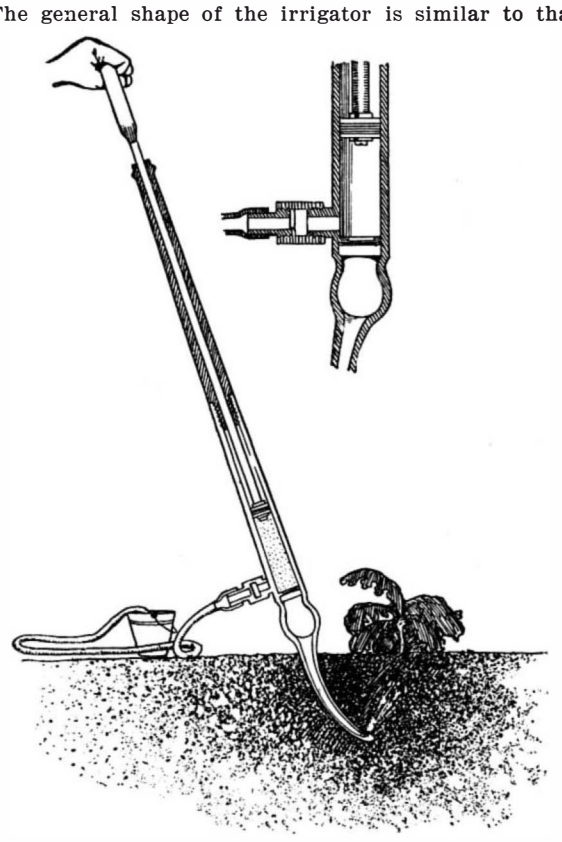
TOY PHONOGRAPH.—It has long been desirable in the manufacture of toy dolls to obtain an economical yet efficient apparatus by which the doll can be made to talk. Such an apparatus seems to have been discovered by the inventor of the device here illustrated. A sounding box of cup-shape is employed, and extending vertically from the top of this box is a strip of celluloid or hard rubber. On this strip the desired sound record is indented. This may be done by softening the strip



TOY PHONOGRAPH.

and engraving by the usual method with the stylus of an ordinary phonograph. A slide block is mounted on the sound-record strip, and is provided with a stylus held by tension of the spring against the sound-record. A handle is provided on the slide block, and by moving this up or down the sound recorded will be reproduced. The construction of the apparatus is so simple that it may be used even in the cheaper toys to reproduce trite sayings and the like in articulate speech.

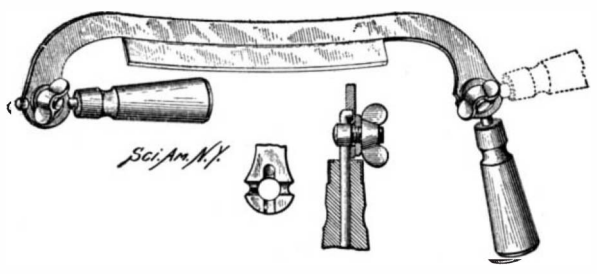
PORTABLE IRRIGATOR.—Among recent inventions in gardeners' implements is one worthy of special notice. The implement is a portable irrigator especially adapted for treating the roots of a plant with fertilizing liquid. The general shape of the irrigator is similar to that



PORTABLE IRRIGATOR.

of a pitchfork, the tines and handle of which are hollow. A piston is adapted to be operated within the hollow handle, serving as a pump to draw the fertilizing liquid from a supply pipe entering at the top of the fork head and to force it out through the openings in the tines. In operation the tines are buried into the ground with their lower ends in proximity to the roots to be treated. The liquid can then be forced out in a fine spray at the point where it will do the most good.

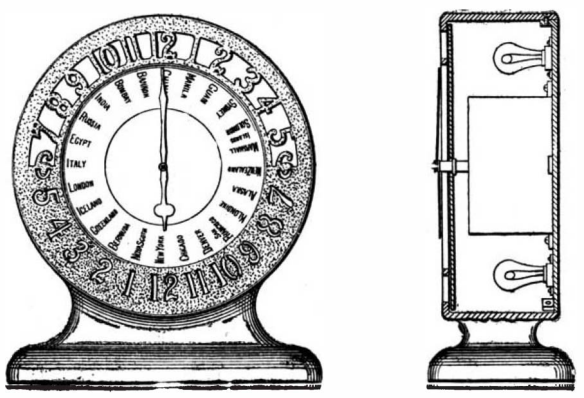
DRAW-KNIFE.—A Yankee inventor has improved on the ordinary draw-knife by providing a knife with handles which may be readily adjusted and locked in various positions. The shanks of the knife blade are



DRAW-KNIFE WITH ADJUSTABLE HANDLES.

provided with ears to which the handles are secured. In each ear is an aperture for receiving the clamping bolt, as shown in the small detail view. Two intersecting grooves are formed on one face of each ear to receive the handle rod. By tightening the thumb screw on the clamping bolt, each handle rod may be firmly locked in any one of the three positions permitted by the intersecting grooves. In order to give greater stability to the joints, each handle rod is provided at the end with a stud or projection. A recess is formed in each end of the horizontal grooves, and a socket at the upper ends of the vertical grooves, which are adapted to receive these projections and insure a firm hold. The advantages of this construction are apparent. It is often impossible to use the draw-knife with its handles projecting at right angles to the blade, because of their interference with other portions of the work. In such cases this improved construction would be a necessity. When the tool is not in use, the handles may be turned inwardly, as shown at the right in the illustration, and the edge of the blade would thus be protected against injury.

GEOGRAPHICAL CLOCK.—The accompanying illustrations show a clock by which the correct relative time of various prominent localities throughout the world may be instantly ascertained. The hour-hand of the clock is provided with a translucent disk secured thereto, which, with the hour-hand, makes one complete rotation every twenty-four hours. On this disk, in their proper locations, are printed the names of different cities or states throughout the world. The twenty-four hours of the day are represented on an outer stationary ring. The characters representing the hours



GEOGRAPHICAL CLOCK.

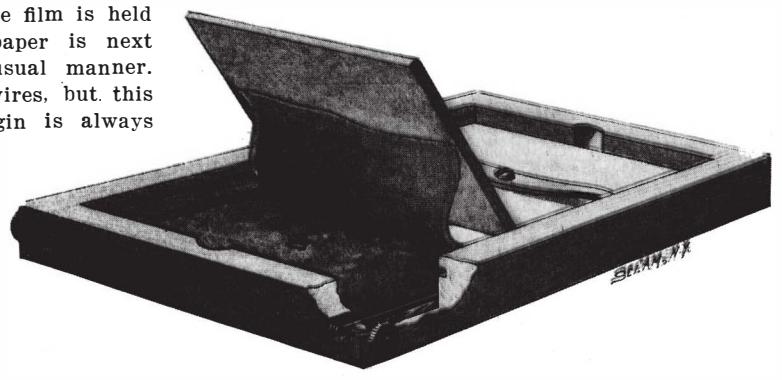
of day are formed in relief, while those representing the hours of night are cut out of the solid background. The translucent disk extends under the ring and serves to display the characters in such manner that one will at a glance distinguish the hours of the day from those of night. Electric lights may be located within the clock casing, so that the characters may be readily distinguished at night. Our illustrations show the clock as indicating midnight in New York, and it will be readily seen that at that hour it is five A. M. in London, one P. M. in Manila, nine P. M. in San Francisco, etc.

PRINTING FRAME.

One of the greatest difficulties attending the use of films is experienced by the photographer when making prints. The tendency of films to curl and twist causes a great deal of time to be wasted in trying to straighten out the negative and lay the edges back to their normal position. Heretofore it has been the practice to soak the negative in glycerine or bend it backward, but these methods are in the one case disagreeable, and in the other non-effective. All photographers will therefore appreciate any device for overcoming this difficulty.

A very simple invention along this line has recently been patented by Dr. F. J. S. Gilbert, of 1921 Canal Street, New Orleans, La. Dr. Gilbert's invention provides a printing frame having two horizontal wires stretched on the glass along two opposite edges. Each wire is secured in the frame at one end, and at the other is coiled about a revoluble pin. Each pin is provided with a milled head, so that it may be turned to increase the tension of the wire.

In operation the wires are first slackened, and the film placed against the glass with its edges under the wires. Now by tightening the wires the film is held smoothly in place. The sensitized paper is next placed, and exposure made in the usual manner. The paper may possibly overlap the wires, but this is not detrimental, for a small margin is always allowed on prints, which is trimmed off before mounting. This printing frame will be found particularly useful for one who desires to make a great many prints from a single negative; for when once fastened in place, the film cannot be disturbed by the ordinary operations of printing.

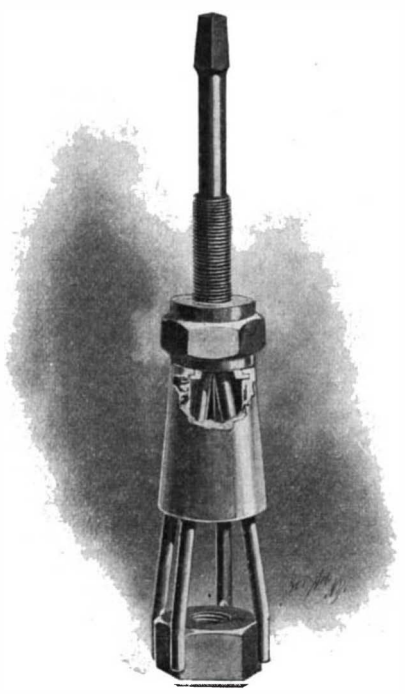


PHOTOGRAPHIC PRINTING FRAME.

The fire department officials of the city of Washington, D. C., have been greatly annoyed for a number of years by the frequency of false alarms of fire. It is computed that every false alarm costs the city $25, and as there were several hundred every year, the thing got to be quite serious. With the view of preventing these, as far as possible, a new alarm box has been adopted and is now being placed about the city. The main feature is that in the course of striking an alarm a light, which burns several seconds, spouts from a cup on top of the box, and this is sufficient to attract attention to the person giving the alarm and would enable any one in the vicinity to identify him. This is known as the Campbell system and is the invention of a resident of the Capital City.

WRENCH.

A recent invention provides a peculiar form of wrench adapted to be used in connection with an ordinary car-



WRENCH FOR USE WITH HAND-BRACE.

penter's hand brace. The novel tool may be employed to engage with angular nuts or bolt heads for insertion into wood or other material. Screw bolts that are cut with coarse threads, and known as "lag screws," may be driven into wood by the use of this tool and a brace much more rapidly than with an open-end wrench.

Briefly stated, the tool comprises a shank having at one end a shank head which may be engaged by a socket of the brace or its gripping chuck and provided at the other end with spreading fingers which may be closed to grip any desired object by adjustment of the sleeve surrounding them. A clearer understanding of the construction may be had by referring to the illustration. It will be noticed that the main shank is provided with four gripping fingers above which is a threaded portion engaged by a nut. Connected to this nut by a swivel joint is the sleeve piece which is slightly flared toward its open end. On the inner surface of this sleeve are a number of longitudinal channels which are spaced apart equally and correspond in number to that of the gripping fingers. These fingers, which are slightly resilient, rest in the grooves in the sleeve and are thus secured against torsional strain when the tool is in use. Downward adjustment of the sleeve obviously presses the fingers together. A square nut or bolt head is gripped by clamping the fingers against the four faces of the butt or screw bolt. With a hexagonal nut it is evident that but two fingers will engage a flat surface while the other two must engage opposite corners. In order that these corners may be securely held, and in order that an even pressure will be exerted by the sleeve on the clamping members, each finger end is provided on its inner surface with a longitudinal V-shaped kerf or channel into which the angle of the nut or bolt head may project.

Mr. James S. Barrett, of 29 South Church Street, Carbondale, Pa., is the inventor of this new wrench.

News comes from Europe that the Norwegian life-saving society has experimented at Horton with Capt. Doenvig's new life-boat. It is said that the device consists of a sphere having a carrying capacity of sixteen persons, 800 pounds of provisions and a half ton of water. An air-pump and a water-pump together with a sail and rudder comprise the propelling machinery. The sphere is intended to stand on the deck, and to float off if the ship carrying it goes down. The trials are said to have been successful.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

HARROW TOOTH-BAR.—T. R. WALLIS, Dyersburg, Tenn. The tooth-bar is a composite structure comprised of a pair of gutter-shape members placed together so as to form a tube. Each of these members is provided with a row of holes into which are fitted the conical shanks of the harrow teeth. The shanks are secured at the top by threaded nuts.

Electrical Apparatus.

ELECTRIC ACCUMULATOR.—F. LOPPÉ, H. P. MORIN, G. J. A. GRINER and D. P. MARTIN, Paris, France. This electric accumulator comprises a plurality of perforated plates, the walls of the perforations having conical projections. An active mass is arranged between the plates and distance pieces are provided at one end to separate the plates which are connected by perforated rivets.

Hardware.

DOOR OR GATE LATCH.—C. J. MOORE, Varina, Iowa. A latch of simple construction is hereby provided that may be readily attached to a door or gate, and serves to hold the same locked in either closed or open position. The parts are so arranged that it will be practically impossible for an animal to move the latch from its locking position by rubbing against it, as sometimes happens with other locking devices.

SAIL-HANK.—J. M. INTO, Newport, R. I. The hook may be permanently fastened to the sail and will not injure the sail by unduly wearing on the bolt rope or sail cloth. It will hold the luff of the sail snug against the stay and is of such construction as to admit of quickly bending or unbending the sail.

CAN-OPENER.—T. H. C. LOFTHOUSE, Nassau, Bahama Islands. Mr. Lofthouse is the inventor of an improved can opener which is characterized by its simplicity and efficiency. The implement possesses the strength and cutting qualities which are necessary for properly cutting the can.

TWINE-HOLDER.—A., L. and O. SOVELIUS, Hancock, Mich. A simple and practical twine-holder has been designed by these inventors which will be found useful for merchants and others. After a package is tied and the twine is cut off, the twine-holder will raise the twine above the counter. Means are provided also for regulating the tension of the twine as it runs off.

Mechanical Devices.

SAW-SETTING MACHINE.—C. YOUNG, York, Me. This improved saw-setting machine is designed for accurately and quickly setting the teeth of saws, notably band saws. The arrangement of the parts is such as to permit easy and quick adjustment of the machine for readily treating all kinds of saws, whether wide, narrow, fine, or coarse.

DREDGE.—A. Z. BOUDREAUX and O. F. ESCHET, Gibson City, La. This invention, which in general relates to improvements in dredges, more specifically comprehends a novel and peculiarly constructed means for automatically opening the bucket or dipper door, and for taking up the slack of the rope that connects therewith during the different adjustments of the dredger boom and the supporting platform.

COTTON-CLEANER.—E. B. HAM and J. W. SHIPLEY, Jennings, Okla. Ty. This invention has for its object to provide means, in the well-known pneumatic tube for handling seed cotton by atmospheric suction, that will thoroughly clear the cotton before it gets to the gin stand. The invention consists in a special cleaning apparatus designed to be located at any desired point in the gin room.

CLUTCH-OPERATING MECHANISM FOR WINDING-DRUMS.—S. BARTRON, Stroudsburg, Pa. Improvements are provided by this invention in devices for moving the winding drum into operative connection with the driving wheel and for disengaging it therefrom. A simple mechanism is employed by which the adjustments may be quickly made while the driving shaft is moving in a winding directon.

LATHE.—O. G. EDMOND, Wausau, Wis. Mr. Edmond is the inventor of an automatic lathe for turning spindles, balusters, handles, and like articles. It comprises means for feeding the work and cutting it off at even lengths, after which the work passes from work-carriers which move arbitrarily and at the same time turn independently around a cutter of the rotary type.

COMPRESSED-AIR WATER-ELEVATOR. W. MCKEE, Charleston, W. Va. An improvement in compressed air water elevators is provided in this invention which relates particularly to the valve mechanism, whereby compressed air is admitted to the pumping chambers and permitted to exhaust therefrom in the operation of the apparatus.

POWER DEVICE FOR PUMPING WELLS. J. J. KWIS, Findlay, Ohio. The invention aims to provide simple and substantial means for holding a vertical spindle in a perfectly rigid condition in the frame work of a power device for pumping wells, thereby effectually overcoming all liability of the power wheel assuming a tilted or canted position. The invention is an improvement on a previous one patented by Mr. Kwis.

MECHANICAL MOVEMENT.—F. J. DONOUGHE, Gallitzin, Pa. Mr. Donoughe's invention is an improvement in that class of mechanical movements involving the principle of a cam wheel operated through the medium of reciprocating devices or agents for the production of work. The invention is applicable for operating oil, water, and air pumps and for a variety of other uses whereby reciprocating motion can be utilized.

SHOE-CLEANING MACHINE.—W. RICHARDSON, Colfax, Wash. The object of this invention is more particularly to provide means for retaining a revoluble brush in a predetermined position relative to the foot-rest, so that the operator after using the brush merely allows it to return to its normal position, where it is convenient for subsequent use.

NAILING-MACHINE.—J. W. REED, Hammond, Ind. The invention relates to nailing machines operated either by hand or power, but more particularly by hand, in which the nails are automatically formed from a wire as the machine is operated. The nails are cut by the cutting die of the hammer shearing past the stationary die in the frame and are driven by the same stroke of the hammer.

Medical Apparatus.

AUTOMATIC MEDICAL ELECTRICAL APPARATUS.—A. F. and J. C. VETTER, New York, N. Y. This apparatus is used for subjecting various parts of the human body to the action of an electrical current. The device is of simple construction and may be readily manipulated being in the form of a handle adapted to be grasped by either hand and which will control the operation of the device automatically.

RESPIRATOR.—M. JACOBS and A. P. BLACK, Brooklyn, N. Y. This respirator requires no outside attachment whatever. It is simply placed over the mouth and held by the teeth or lips and may be instantly applied or removed. It is a positive protection against inhaling microbe-laden dust in summer, and it tempers and filters the cold air in winter. As an inhaler of such medicaments as chloroform, menthol, turpentine, etc., the device will serve the same purpose as a more expensive and cumbrous device.

Railway Improvements.

EXPANSION JOINT-COUPLING FOR TRACK-RAILS.—J. W. MCBURNEY, Fort Palmer, Pa. A novel and simple coupling device has been provided by this invention, which is adapted particularly for holding railroad track-rails connected at their joints in a reliable manner, and which will afford compensation for expansion of the rails during hot weather.

AUTOMATIC PHOTOGRAPHIC DETECTOR DEVICE FOR PASSENGER CARS.—F. W. BROOKS, Brooklyn, N. Y. The invention consists in the main of the following parts: First, a device connected with and operated by the revolution of the car wheel, and an electrical connection by which the operations of the camera and registers and the distance between such operations are actuated and controlled; second, an electric current, preferably from a battery, connected with the above device by which the circuit or circuits are opened or closed to operate the camera, the registers, and the lighting of the car; third, a method for automatically lighting the car in such portions as are desired, and means for shutting off conflicting or objectionable lights.

RAIL-JOINT.—D. O. BRUNNER, Somerset, Ohio. The invention has for an object the provision of improved means for protecting the meeting or adjacent ends of two rails from the pounding or hammering action of the wheels of passing cars, thereby contributing to the easy and smooth running of trains, reducing the tendency of the parts to work loose, and minimizing abrasion and wear of the joint.

Miscellaneous.

MOTOR-VEHICLE.—A. E. OSBORN, New York, N. Y. Various improvements in the framing of motor vehicles are provided by this invention in order to effect as direct a connection as possible between the motor and driving wheel which is also arranged to steer the vehicle. The frame is approximately triangular in form and the vehicle has three wheels, one in front serving as both the driving and steering wheel. The motor is mounted on a separate frame which swings with the steering wheel.

ROPE-GUIDE.—W. G. POULSON, New York, N. Y. The purpose of this invention is to provide a new and improved rope-guide for the hoisting and lowering ropes of dumb-waiters and the like. The guide is simple and durable in construction, cheap to manufacture, easily applied, and so arranged as to prevent chafing and breaking of the ropes and abrasion of the wood adjacent to the guide. The friction between the rope and the guide is reduced to a minimum, and hence raising or lowering of the cage or box may be accomplished without much exertion to the operator.

FASTENING FOR WATCH-DIALS.—W. W. DICKERSON, Wilson, Kans. Various attempts have been made to provide a secure fastening for dial plates of watches, but the object has still not been completely attained. Mr. Dickerson is the inventor of an improvement in this line whereby the difficulties attending the usual construction and arrangement of dial plate fastenings are avoided and certain important advantages are attained.

BAKE PAN.—C. E. and G. M. AUSTIN, Rollinsford, N. H. The pan is designed especially for use in the baking trade for biscuits, cakes and like articles. It comprises a certain novel structure preferably struck up from a single sheet of metal and having a bottom flanged at each side so as to make the pan reversible, and also so as to leave a space beneath the bottom at all times through which hot air may circulate freely.

REVOLVING TURRET.—PHILIP HICHBORN and AUGUST O. BOSTROM, Washington, D. C. This revolving turret is adapted for large and small caliber guns and is of a double or superposed type. In carrying out the invention the turret is designed in two partly elliptical parts differing in size and arrangement, the smaller part or gun chamber being superposed on the other or base part and also placed back from the front of the ladder, and both having sloping fronts.

LIMEKILN.—A. P. BROOMELL, York, Pa. Mr. Broomell's invention relates to improvements in kilns of the class used for roasting lime-rock. It primarily seeks to provide a kiln especially designed for burning lime by producer gas in a convenient and effective manner. The invention comprehends a novel construction including a steel shell having a base portion for firmly resting on the ground and having a special bottom constructed for supporting the upper portions of the kiln, including its brick and the rock in the course of burning.

SELF-CHALKING HOLDER FOR CHALK LINES.—W. C. FILSON, Point Pleasant, W. Va. A simple, durable and economic form of device has been invented by Mr. Filson, which device is adapted to contain a reel and chalk line, and a cake of chalk, all of which are easily placed in or removed from a receptacle. When the line is unreeled, the cake of chalk will rotate with the reel and the line will engage the chalk, but when the line is being wound up, the chalk is arranged to remain stationary and out of engagement with the line, thus preventing undue waste of chalk.

GAME APPARATUS.—A. S. ALEXANDER, New York, N. Y. The invention relates to a modification of table tennis or ping pong, the chief variation being the provision of two nets spaced apart vertically. By this arrangement the game is rendered more difficult to play as the players must propel the ball either through the opening between the nets or over the upper net.

COW-MILKER.—E. A. NUGENT, Unionville, N. Y. Mr. Nugent is the inventor of an improved device by means of which milk may be delivered directly from the cow into receptacles held in an air-tight tray from which the air is exhausted. Means are provided for sealing the bottles before removal from the tray, thus preventing the entrance of impurities from the air in a stable, and preserving the milk for a greater length of time than is possible when air is contained in the bottles with the milk.

REDUCER FOR OVEREXPOSED PHOTOGRAPHIC PLATES.—H. G. KRIEGER, Chicago, Ill. Mr. Krieger's improved reducer consists of a mixture of a saturated solution of copper sulphate four parts, and ordinary hydrochloric acid, one part. This solution may be diluted to any desired extent, it being found that even if mixed with ten times its weight in water, it is stll effective, but acts very slowly. Its principal advantages are its simplicity, quickness, cheapness, and reliability.

SCALE.—J. A. HEYDRICK, Butler, Pa. Mr. Heydrick's invention provides an improved scale more especially designed for the use of surveyors, engineers, draftsmen, and other persons, and arranged to permit of conveniently and accurately finding the scale on which a plot, for instance, is drawn, for reducing or enlarging drawings on any scale, for registering units of linear measure and decimal parts thereof, for giving the angle from a line drawn on a map at any point of the line, and for other similar purposes too numerous to mention.

PIN-KEEPER.—C. G. PINGEL, Butte, Mont. The keeper is designed for use in connection with pins. brooches, and the like. The construction is such that the keeper will be moved to locked position by the insertion of a pin, covering the pin point and thus preventing any possibility of the point scratching a person or becoming caught in a dress, or the like.

Designs.

DESIGN FOR A COVER-DISH.—R. L. JOHNSON, Hanley, county of Stafford, England. The cover of the dish is provided with a scalloped edge and decorated border. At the center of the cover ovi-formed projections are grouped at intervals and a floral handle appears in their midst. The body of the dish is ornamented at its upper edge with a border corresponding to that of the cover. The base has a scalloped lower edge and is decorated with a scroll border adjacent to the edge.

DESIGN FOR WALL BRACKET.—F. C. POTTER, New York, N. Y. The leading feature of the design consists in the representations of the insignia emblematic of the Masonic order and the representation being arranged and united to form the back and brace of the bracket.

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(8752) R. R. S. asks: Is there any reason why the alternating current induced in a coil, if transformed without loss to direct current, cannot be used for all purposes, the same as that induced in the armature of a direct-current dynamo? A. We know no reason whatever why any alternating current, when transformed to a direct current, may not be used for any purpose for which the same direct current produced in any other way could be used. An induction coil does not necessarily give an ordinary alternating current, nor can any current be transformed without loss. 2. Are all currents of electricity alike? A. All currents of electricity are not alike any more than all currents of water are alike. They differ in pressure and in volume as do currents of water. We may have a small stream or a large stream with a slight fall; or we may have a small stream or a large stream with a great fall. This gives four sorts of waterfall, with their resultant effects. A battery current such as is used in ringing bells is usually a small current with a small drop of potential. A lightning flash is usually a small current with an enormous drop of potential. A current used for heating is usually a large current with a small drop of potential. A current to be transmitted to a great distance is usually a rather small current with a high potential. The effect in each case varies with the character of the current.

(8753) W. A. H. G. asks: 1. Can a plain slide valve steam engine be run by compressed (hot) air, or must the valves or packing be changed? A. Any engine that is suitable for steam is equally suitable for compressed air. 2. When air is compressed to one-fourth its volume, would it have four times the pressure (60 pounds per square inch)? Immediately after the air is compressed, its temperature will be quite high. After cooling, how much would the pressure decrease? A. Air compressed to one-fourth its volume without loss of heat will have a pressure of 89 pounds per square inch, or 60 pounds without heat, isothermal.

(8754) W. H. D. asks: 1. Is the hot flame from a needle hole through which passes the hot gases of vaporized kerosene a "boring" flame, as common gas is held to be, even on iron? A. All vapor gas jets when made to impinge on any body that will burn by heat may be said to be a boring flame. 2. If it is not a boring flame, is it advisable to apply it, in the firepot of a furnace, directly to the sides of the firepot to heat water or generate steam for house heating? A. A jet flame of any kind should not impinge directly upon a firepot, but directed around it. 3. If it is a boring flame, how can it be applied most economically for such heating? A. By jetting the flame around the firepot in a chamber of firebrick. 4. How can this fuel and flame be applied most economically to furnaces heating by hot air? A. By jetting the flame against a firebrick surface in the fire chamber. 5. We were much interested in your article on oil burners, but you did not give the furnace phase of the question. It will interest thousands of your readers. What burners are best adapted for such? A. There are a number of oil burners on the market which must be operated by steam or air pressure. 6. I have looked through shelf after shelf of engineering works, yet find no tabular schedule of atmospheric pressure, barometric height, altitude and boiling temperature. A. "Compressed Air and Its Applications," by Hiscox, contains a full table of barometric heights and boiling temperature of water (page 38): $5 by mail. 7. As pressure exceeds normal, is the temperature of water the same as the steam? A. Yes. 8. When the steam gage shows pressure of 1 pound, does it not mean 1 pound *above atmospheric*? A. Yes. 9. According to all formulæ of heating, it seems to me a mathematical certainty that shutting off radiators in unused apartments economizes fuel in just the ratio of such cubic space or radiating surface. Yet I find men who contend there is no economy. My experience is in accordance with my belief and formulæ. A. Our experience is in the line of economy from closing radiators when not needed.

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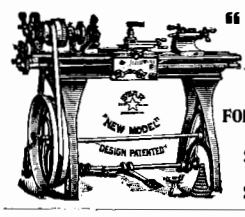

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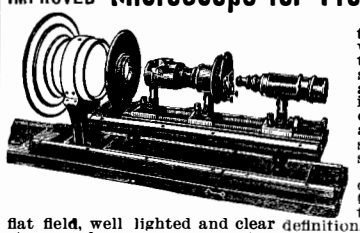

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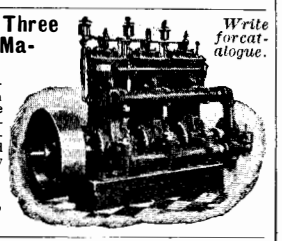

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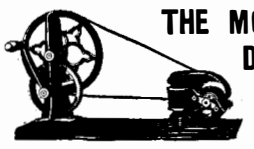

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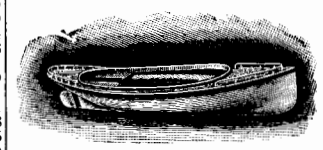

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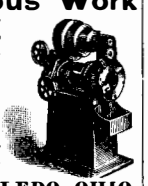

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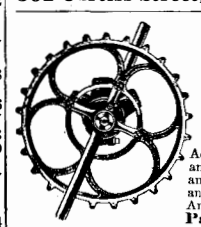

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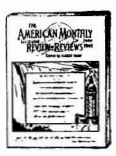

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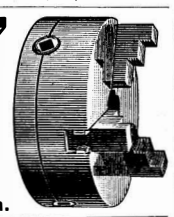

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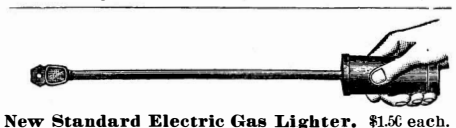

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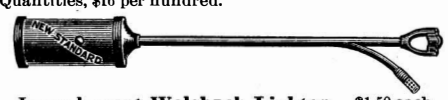

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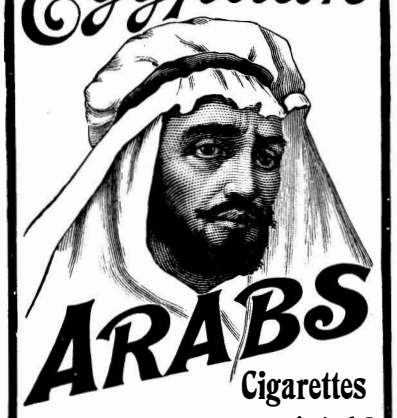

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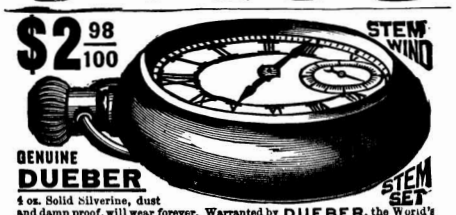

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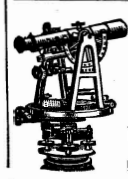

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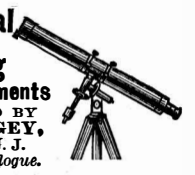

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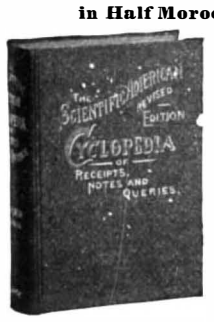

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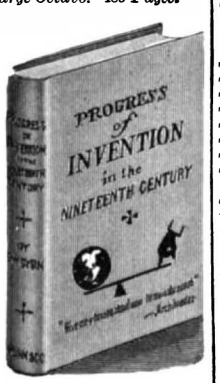

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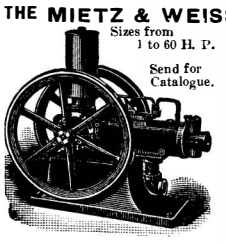

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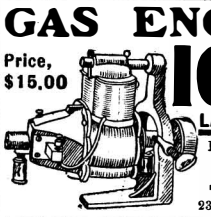

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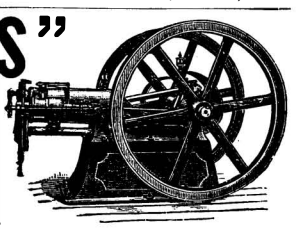

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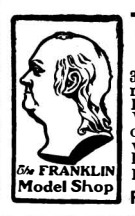

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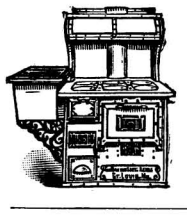

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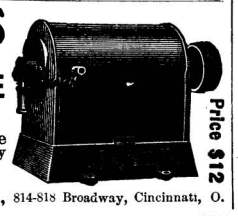

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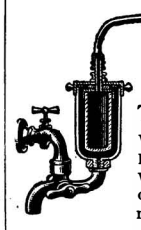

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DEPARTMENT OF THE INTERIOR. U. S. Geological Survey. The Geology and Mineral Resources of a Portion of the Copper River District, Alaska. By Frank C. Schrader and Arthur C. Spencer. Washington: Government Printing Office. 1901. Royal 8vo. Pp. 94.

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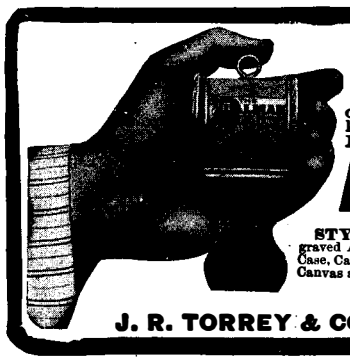

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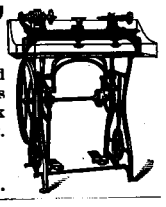

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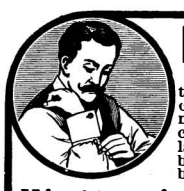

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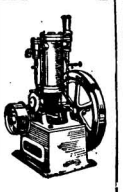

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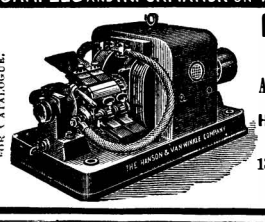

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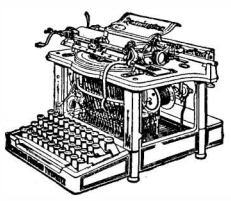

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